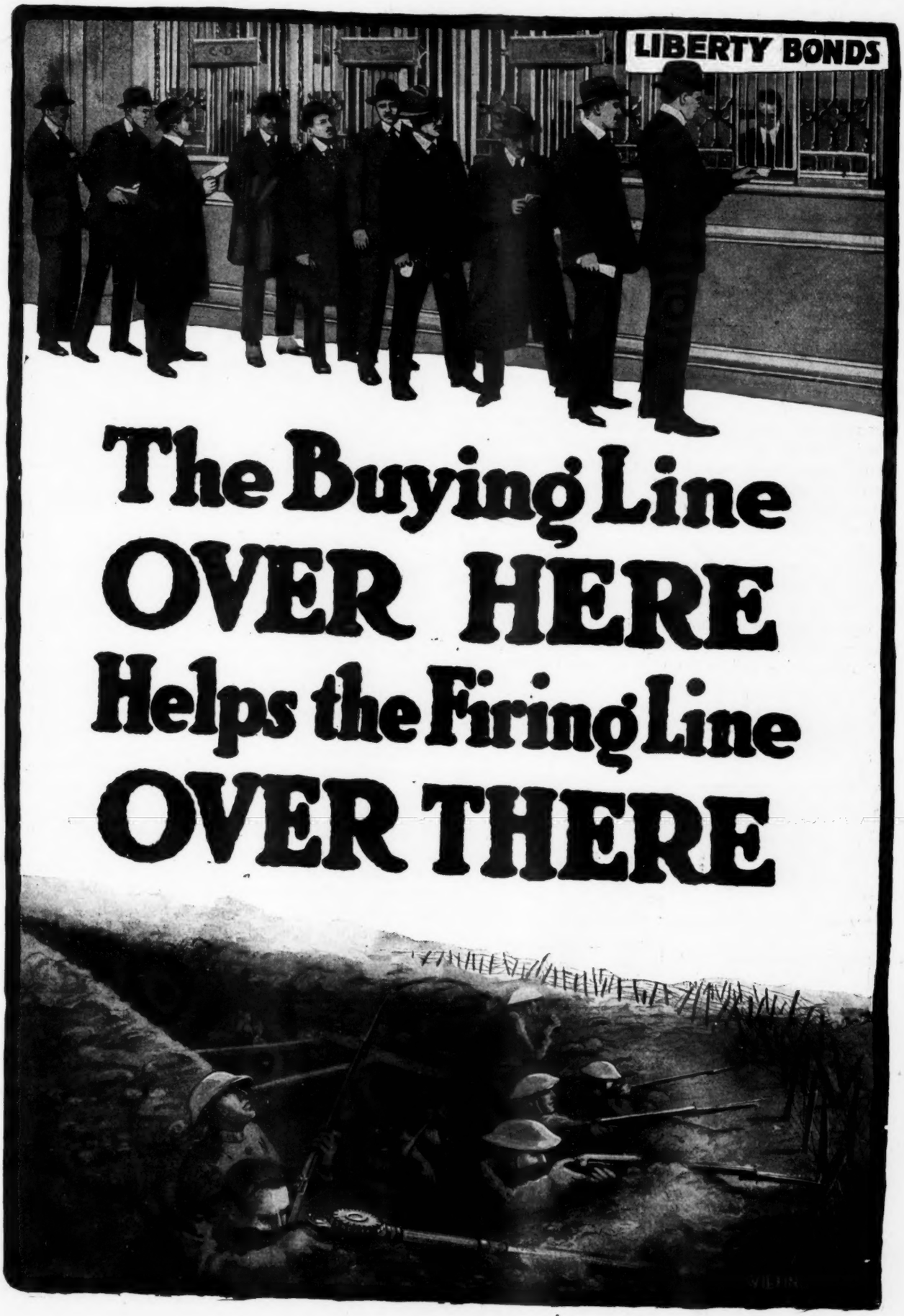
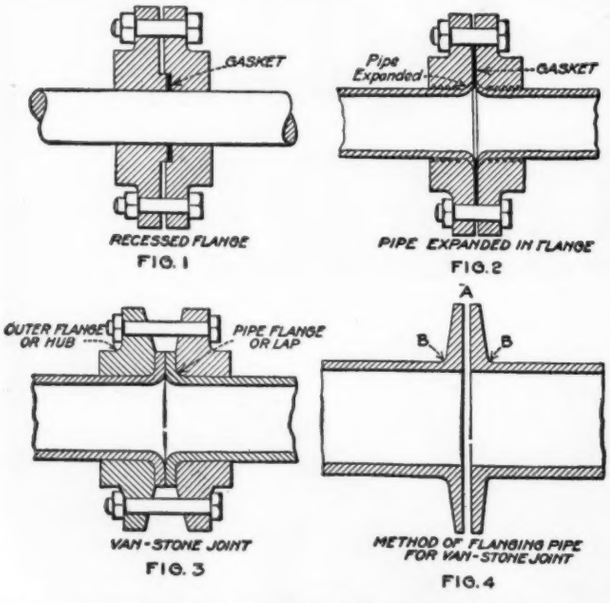

LIBERTY BONDS
The Buying Line
OVER HERE
Helps the Firing Line
OVER THERE

Underground Steam Mains

By CHARLES L. HUBBARD

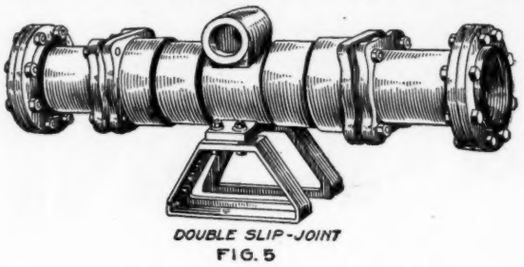
While the construction details of underground mains are much the same as for any other piping of large size, the fact that they are less accessible in case of repairs makes it necessary to use extra care in their installation. Furthermore, the greater length of run as compared with ordinary power-plant or heating work makes the matter of expansion one of much importance, which calls for special provision and anchors.

THE method of making the joints will depend upon the pressure and temperature carried on the system. For heating, both by steam and water, the lengths of pipe are commonly put together with screwed couplings, placing flanges at sufficiently frequent intervals to facilitate the removal of sections should occasion require, but, so far as possible, advantage should be taken of the flanged joints which must be put in for other purposes and in this way reduce the cost of installation. These flanged joints will occur at bends, take-offs to buildings, expansion joints and anchors. For the low pressures carried on heating work, the plain flange with a good form of flexible packing gives satisfactory results and allows of a section of pipe being easily removed, which is a more difficult matter with a recessed flange on heavy piping. A gasket of "soft" packing will make up for any small inaccuracies



FIGS. 1 TO 4. TYPICAL FLANGED PIPE CONNECTIONS

in the alignment of the pipe and is not so likely to permit a leak should the line settle slightly. Corrugated copper gaskets have been used with satisfactory results. If a recessed joint is to be used, the male-and-female type, shown in Fig. 1, is preferable to the tongue-and-groove flange, being easier to pack when in place. The depth of recess is made just sufficient to hold the packing in place, varying from $\frac{1}{16}$ to $\frac{1}{8}$ in., according to the size of pipe. There is danger of leaks developing where the flanges are joined to the ends of the pipe—that is, when the pipe does not extend through the flange—because there may be sand holes in the casting, imperfect threads, etc.; but this is guarded against in various ways, one of the simplest and most satisfactory being by threading the pipe with a full taper, then screwing



FIGS 5 AND 6. DOUBLE SLIP-JOINT AND ITS LOCATION IN A LINE

the flange on by power until the end of the pipe projects through about $\frac{1}{16}$ in., then facing off in a lathe. Another method is to round off the inner edge of the flange and expand or peen the end of pipe into it, as in Fig. 2.

For lines carrying high pressure, and especially highly superheated steam, more care must be taken in the construction of the joints. While there are many types of higher-pressure flanges in use, some form of the Vanstone joint is probably employed more frequently than any other. The principle of this joint is illustrated in Fig. 3 and consists essentially of flanging the ends of the pipe and drawing them together by means of a pair of loose flanges or hubs slipped over the pipe, which act as a clamp. In order to give sufficient strength, the flanged ends of the pipe must be thickened either by upsetting or turning over a flap to get the extra thickness. As it is difficult to get a perfect weld in the latter case, it seems best to first upset the end of the pipe to obtain the necessary thickness, which should be at least equal to the normal pipe walls after machining on both sides.

The form shown in Fig. 4, in which the stock is somewhat thinner at *A* than the pipe wall and slightly thicker at *B*, has given satisfactory results. Finishing the flange or lap is of much importance, and in general it should be machined on both sides to get a tight and durable joint, although in some cases only the face is finished when the back is accurately formed and the scale carefully removed. Tests made on joints of this construction show that the laps will hold considerably more pressure than the bolts, and with specially designed flanges and bolts it has been shown that the pipe will burst before the joint will give way. To make a lasting joint, the pipe flange should fit snugly in the hub of the outer flange in order to give it the proper support.

For pressures above 150 lb. the outer flanges should be of the "high-hub" type, made of rolled, forged or cast steel. While a joint of this type may be made tight without a gasket, by grinding, it is not usually advisable in case of inaccessible mains, because a ground joint is expensive and, even if properly made, may become loosened by the tremendous forces of expansion and contraction. It is therefore recommended that the bearing faces be given a fine tool finish and be provided with a gasket suitable to the pressure and temperature carried. The ordinary corrugated copper gasket has given satisfactory service for saturated steam, but does not seem to be good for superheated steam, owing to a tendency to pit out in some part of the flange from some undetermined cause. In place of copper soft Swedish steel coated with "Smooth-on" cement has been satisfactorily used. Gaskets made up of copper on bronze surrounded with asbestos have also been made use of.

The life of the gasket depends largely upon the method of pulling up the bolts. If the joint is first drawn up on one side and then on the other, there is almost certain to be trouble with the gasket, but instead of this procedure the bolts should be taken up gradually and evenly all around the flange.

The welded joint is made use of in two ways—either by welding heavy flanges to the ends of the pipe and bolting them together or by uniting the ends of the pipe without flanges. Welded flanges are used where the piping is to be removable or where it is to be joined to a fitting, but joints of this kind are more expensive than the Vanstone type because all finishing must be done on heavy sections of piping, instead of a portion of it being on small individual flanges that are easily handled. Welding the ends of the lengths of pipe, without the use of flanges, is accomplished by means of the oxyacetylene torch or the thermit welder and is successfully employed in laying lines of underground piping for water, steam and high-pressure gas. While the work may be done with the oxyacetylene torch in any position, the best results are obtained when the pipe is rotated so as to do all the welding from the top.

A committee of the National District Heating Association, in 1915, investigated the matter of pipe welding and reported the cost to be from 25 to 50 per cent. less than for screw couplings, depending upon whether the work was done on the bank or in the trench. The cost per joint at that time, for labor and materials for work done on the bank, was estimated as follows: 4-in., $0.44; 6-in., $0.57; 8-in., $1.06; 12-in., $1.57; 16-in., $2.21. The cost for welding in the trench was estimated at twice the foregoing. If it is necessary to remove a section at any subsequent time, it is easily cut out by means of the oxyacetylene flame and a new piece of piping welded in by the same means.

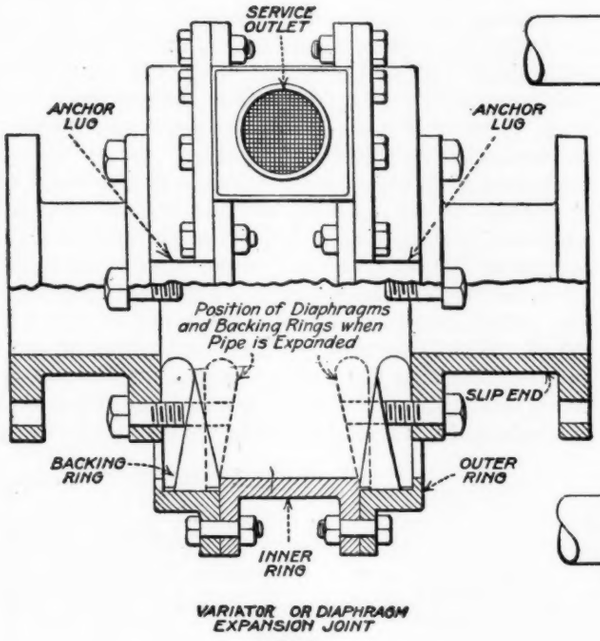


FIG. 7

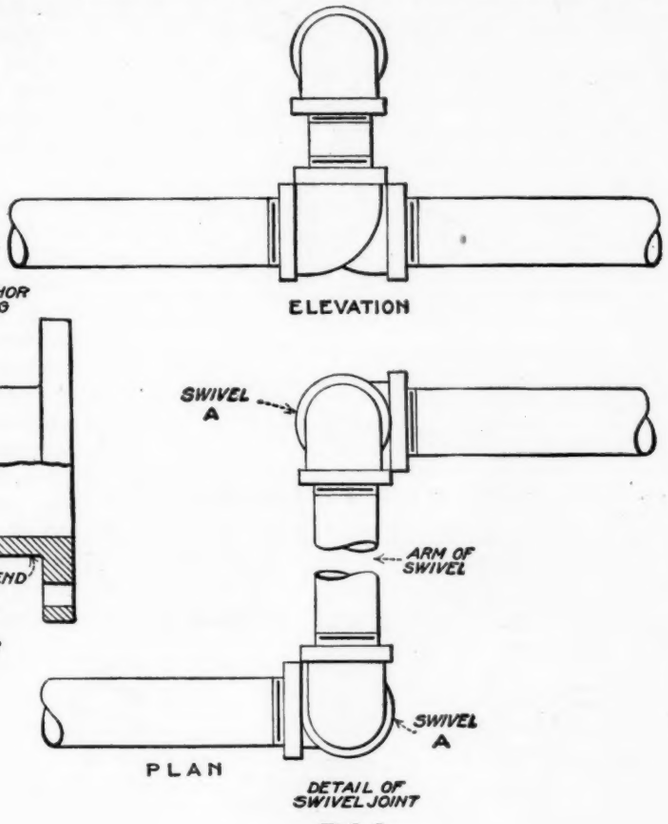


FIG. 8

FIGS. 7 AND 8. TWO FORMS OF EXPANSION JOINTS IN GENERAL USE

The expansion of wrought-iron and steel pipe under different conditions may be determined by the formula,

$$l = 0.00009(T_1 - T_2)L$$

in which

l = Increase of length, in inches;
T_1 = Temperature of steam in pipe;
T_2 = The lowest temperature to which the pipe is to be subjected;
L = Original length of pipe in feet.

The factor 0.00009 is obtained by multiplying the

coefficient of expansion, 0.0000075, by 12, in order to reduce the length L to feet, which puts the formula in more convenient form for general use.

Example: A main 1000 ft. long was fitted at a temperature of 60 deg., the lowest considered, and carries steam at 150 lb. pressure and 100 deg. superheat. What will be the increase in length due to expansion?

Here, $T_1 = 366 + 100 = 466$, $T_2 = 60$ and L 1000. Substituting in the formula gives $l = 0.00009(466 - 60)1000 = 36.5$ in., or practically 3 ft. This shows the importance of providing means for taking care of the variation in length so as to avoid throwing undue strain on pipe and fittings. In low-pressure steam and water heating the expansion is much less, owing to lower working temperature. In work of this kind the increase in length will not usually exceed 1.5 in. per 100 ft. of run.

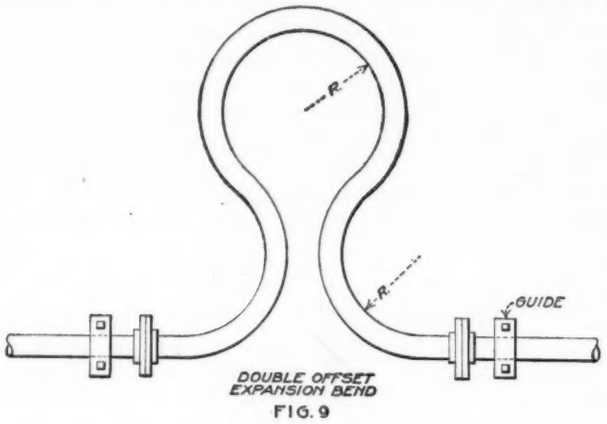


FIG. 9

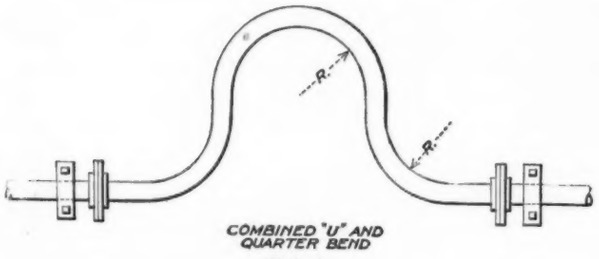


FIG. 10

FIGS. 9 AND 10. STANDARD FORMS OF EXPANSION BENDS

There are three methods commonly employed for taking care of the expansion in long runs of piping—expansion joints, which include slip joints and variators; swivel joints; and loops. The objection to slip joints is the difficulty in keeping them in working adjustment, for if the gland is drawn up too tightly the joint will not slip, and on the other hand, if too loosely adjusted leakage will take place. In order to get the best results, the pipe line must be securely anchored at suitable points and also properly supported upon either side of the joint to prevent sagging and binding.

A simple way of combining all of these requirements in a single fitting is shown in Fig. 5, which illustrates double-slip joint, outlet and anchor. The method of installing this in the line and its relation to other anchors is shown in Fig. 6. Joints of this type should be so spaced that the maximum slippage will not exceed five or six inches, which in the case of low-pressure steam or hot-water heating will mean every 300 or 400 ft. A typical expansion joint of the "variator," or diaphragm, type is shown in Fig. 7. In this case the expansion and contraction are taken care of by a pair of flexible copper diaphragms of a special form. Joints of this design avoid the use of stuffing-boxes and all adjustments, thus making them especially adapted to underground work. It is, however, a patented device and must therefore be obtained from the manufacturers.

The swivel joint, or expansion loop, is also made use of in places where suitable. The first of these is usually adopted where long-radius bends are not practicable on account of lack of space and where screwed fittings or joints of the Vanstone type are used. A diagram of this arrangement is shown in plan and elevation in Fig. 8, which illustrates how any lengthening or shortening of the line is taken up by a slight turning or swivel movement at the flanges at points A. When there is ample space, long-radius bends are preferable to any other method, especially for high-pressure work. In this case all movement of the pipe is taken up by the elasticity of the metal, thereby doing away with any movement at joints. A typical expansion loop is shown in Fig. 9, and as the pipe itself is under an enormous strain, it is evident that the loop must be carefully proportioned in order not to overtax any part of it.

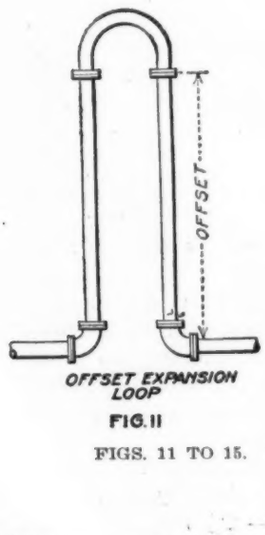


FIG. 11

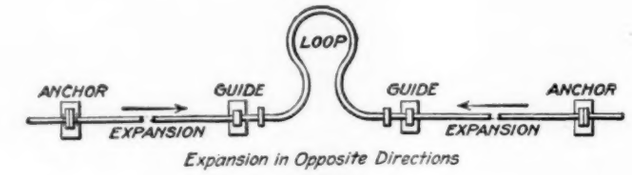


FIG. 12

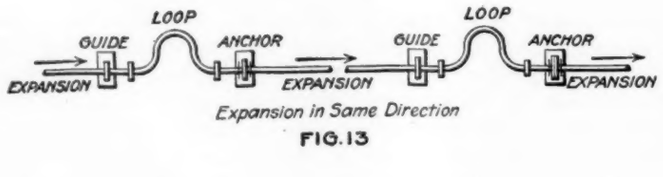


FIG. 13

FIGS. 11 TO 15. LINE CONSTRUCTION WITH EXPANSION LOOPS AND ANCHORS

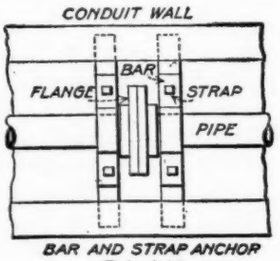


FIG. 14

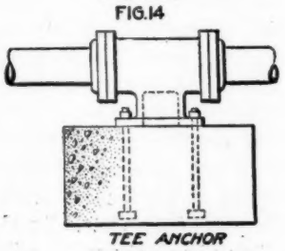


FIG. 15

Table I, made up from curves published some time ago in the *Electrical World*, gives the maximum allowable expansion for different sizes of pipe with varying radii of bend of the general form shown in Fig. 9.

For example, a loop of the form shown in Fig. 9, made of 8-in. pipe and having bends with a radius of 70 in., will safely care for 8 in. of expansion. When

TABLE I. ALLOWABLE EXPANSION, IN INCHES

Diameter of Pipe, Inches	Mean Radius of Bend (R Fig. 9) 30	40	50	60	70	80	100
3	3	6	9	13	18	...	...
4	2.5	4	7	10	14	18	...
5	...	3	6	8	11	15	23
6	...	..	5	7	10	12	20
8	...	..	..	6	8	10	15
10	...	..	..	4	6	8	12
12	...	..	..	3	4.5	6	10
14	...	..	..	..	4	5.5	8

the loop is of the form shown in Fig. 10, take 80 per cent. of the expansion given in Table I for the same pipe size and radius of bend.

These figures are based on the strain in the pipe, and any strain at the flange joints other than that parallel with the axis of the line should be guarded against by guides, as indicated.

Sometimes the expansion loop is made up of a pipe bend and fittings, as in Fig. 11, in which case Table II may be used to give the required length of offset for different amounts of expansion and different sizes of pipe. These figures take into account the strain on the fitting as well as on the pipe and are therefore somewhat higher than would be required if the fiber strain of the pipe alone were considered.

The inner radius of the bend at the end of the loop should never be less than five diameters of the pipe, and a length of straight pipe equal to two or three

TABLE II. LENGTH OF STRAIGHT PIPE IN OFFSET, IN FEET (Fig. 11)

Expansion in Inches	Diameter of Pipe, Inches 3	4	5	6	8	10	12	14
1	7	8	9	10	11	12	13	14
2	9	11	12	13	15	16	18	19
3	11	13	15	16	18	20	22	24
4	13	15	17	19	21	24	25	28
5	15	17	19	21	24	27	29	32
6	17	19	20	23	26	29	32	35
7	18	20	22	24	28	31	34	37
8	20	22	24	26	30	33	36	40

diameters should be provided at each end for handling in the process of bending. In order to distribute the expansion evenly between the different joints or loops, it is necessary to anchor the pipe at regular intervals. The method of placing the anchors for a double-slip expansion joint is shown in Fig. 6, in which case the expansion is toward the joint from either side, as indicated by the arrows. This arrangement is also applicable to an expansion loop, as in Fig. 12. When it is desired to use shorter loops, they may be placed close together and the expansion made to take place continuously in one direction, as in Fig. 13, which shows the arrangement of guides and anchors with reference to the loop. The layouts shown are for long lines of pipe. It frequently happens in practice that sufficient offsets and changes in direction are necessary to reach the different buildings to furnish a considerable part of the flexibility required without the use of special joints. Conditions of this kind should be fully taken advantage of in order to simplify the construction and reduce the cost of installation.

Various methods are employed for anchoring a pipe line, depending upon local conditions. A simple form that may be applied at any flanged joint or offtake fitting is shown in Fig. 14, and is self-explanatory. Another, formed of a tee fitting with the side outlet closed, is illustrated in Fig. 15. This requires a special foundation built into the conduit to which the flange of the tee is bolted. All expansion joints of the slip or "variator" type which have moving parts should be placed in manhole chambers where they are readily accessible. Expansion loops should have ample room to expand in the conduits or chambers without coming in contact with the side walls or other piping. The method of support will depend largely upon whether the pipes are carried through tunnels or conduits of comparatively small size and is best taken up in connection with tunnel and conduit construction.

Boiler Explosion at Providence, R. I.

BY H. S. KNOWLTON

A sixty-inch horizontal return-tubular boiler at the Mt. Pleasant Wet Wash Laundry, Providence, R. I., exploded at 6:40 a.m. Monday, Mar. 4, killing three persons, seriously injuring four others and completely wrecking the establishment. The boiler was being fired by one of the proprietors, who was killed. It was inspected July 15, 1917, by E. W. Farmer, city boiler inspector of Providence, and was reported then in first-class condition. Business growth at the laundry led to the recent purchase of two large washers, which

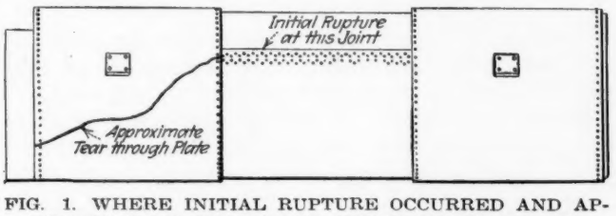


FIG. 1. WHERE INITIAL RUPTURE OCCURRED AND APPROXIMATE PATH OF TEAR THROUGH FIRST SHEET

were being placed in service for the first time on the morning of the explosion.

The boiler contained sixty 3-in. tubes 16 ft. long and was hand-fired. It supplied steam to a small single-cylinder engine and to the various steam-heated machinery housed in the laundry, a 50 x 60-ft. one-story wooden structure. As the fireman was instantly killed, it is impossible to determine with exactness the condition immediately preceding the explosion, but one of the partners of the concern, who passed through the boiler room at 4:30 a.m., states that at that time the steam gage showed a pressure of 55 lb. and that about four inches of water was showing in the gage-glass.

Examination of the boiler after the disaster disclosed no apparent structural defects. The boiler sheets had no indication of having been burned or of crystallization where the fracture occurred. The explosion tore the boiler in two. The rear sheet and tube head, Fig. 2, were thrown backward to a point just behind the original location of the boiler. The other section, comprising the center and front sheet, Fig. 3, opened up, the shell being torn away from the tube sheet and flattened out in an irregular plate. Many of the tubes were blown out and scattered about the neighborhood for distances up to 600 ft., but the damage was slight excepting in the laundry itself.

From the appearance of the wreckage it is deduced that the initial failure occurred in the longitudinal

seam of the center sheet and extended to the girth seam between the first and second sheets. From this point the first sheet was torn diagonally through the solid metal to the front head about as shown in Fig. 1. The opening up of the center sheet tore through the rivet

FIG. 2. REAR SHEET OF THE EXPLODED BOILER

holes on the girth seam, as shown in Fig. 2. A portion of the sheet of the rear section was torn instead of the rupture following the rivet holes of the girth seam.

The boiler was of the single butt-strap double-riveted design, the rivets being $\frac{3}{4}$ in. in diameter, spaced 3 in. apart on centers and staggered in rows 2 in. apart. The shell plate was $\frac{5}{16}$ in. thick. In the rear section six of the tubes remained attached to the tube sheet, and although some of these were flattened out and bent, no signs of fracture could be seen. There was a slight pitting on the front tube sheet, and a little pitting was noticed on the side of the larger sheet fragment.

Most of the braces, which were $1\frac{1}{4}$ in. diameter, remained in place in the rear section of the boiler, the rivets of which held with the exception of three at the girth seam, which were in a longitudinal joint, these three being sheared off.

The boiler had not been operated for about 48 hours prior to opening the laundry on the morning of the explosion, but there had been a pressure of about 20 lb. throughout the night. The boiler was operated at 75 lb. pressure; it was about six years old and was allowed a maximum pressure of 100 lb. The safety valve was of the ball-and-lever type and was connected to the boiler by a cast-iron nozzle of light construction. The safety valve had not lifted from one year's end to the other, and on the night before the explosion the partner who was killed moved the ball out to the end of the lever, which put the blowing-off point to 120 lb. instead of 100, allowed on the inspection certificate, and 75 lb., the normal operating pressure.

Summing up, the evidence is that the boiler operator was not experienced; the single butt-strap joint on the longitudinal seam was of poor construction; the violence of the explosion indicates that there was plenty of water and a high steam pressure. A sticking safety valve, together with the weight moved to the extreme end of the lever and a hot fire in the furnace, left to take care of itself (as was done while the engine and other machinery was being got ready for starting up) are the probable causes for the explosion.

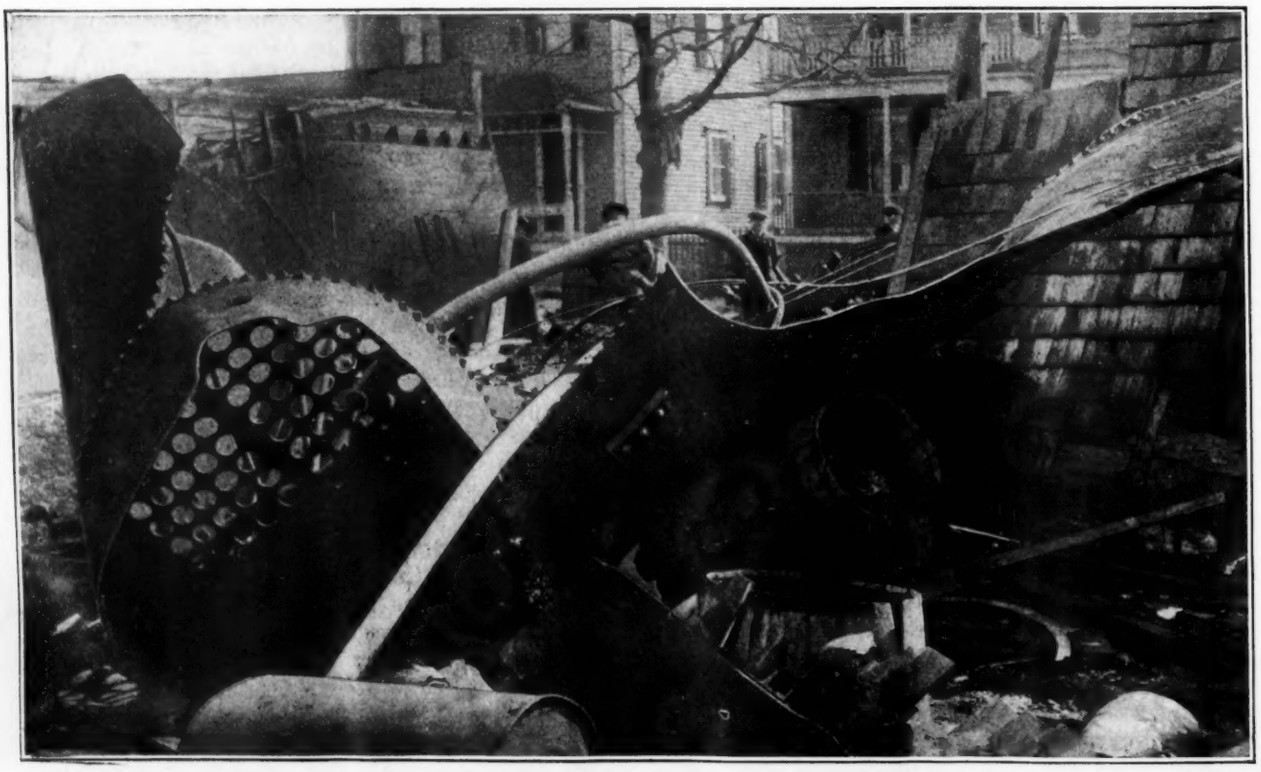


FIG. 3. FRONT TUBE SHEET AND FIRST TWO SHELL SHEETS

Hydro-Electric Power Development in Australia and New Zealand

By LUDWIG SCHMIDT

An account of the present state of hydro-electric development in Australia and New Zealand, the proposed extensions and new enterprises, and a brief outline of the legal conditions under which the water-power resources are made available.

THE utilization of the water-power resources of the Australian continent, if not exactly a monopoly of the government, is at least a prerogative secured to the nation by a series of laws passed during the last twenty or thirty years. As these laws are similar, it will be sufficient to give the principles of the law of the State of Victoria, which was passed in 1896. According to this law, the state reserves to itself the right to generate electrical power including that drawn from natural sources. This right can be delegated to others under a special license, which, however, in the case of a person or a private corporation, cannot run longer than thirty years. At the expiration of the term the license may be renewed at the option of the state, under modified conditions which apply mostly to the optional powers of the municipalities or the state to acquire, when desired, the property of the licensee for the purpose of municipal or state operation. No electrical enterprise can be undertaken without the issuance of a special order or permit. This stipulation, however, does not apply to private undertakings, such as installations made in factories and for similar purposes. The carrying of overhead lines requires special permission by the local or government authorities, as the case may be. High-pressure transmission lines are subject to special control. The government retains the right to review the rates charged, and no enterprise may discriminate against any consumer as to distribution or charges.

Distribution of Operating Licenses in Victoria

Under this law 107 licenses were issued in Victoria from 1896 to 1914, of which 57 allowed the operation of municipal enterprises, 49 applied to private and corporate enterprises and one was given to the government. As to the influence of the laws governing transmission of power, the result has been a preponderance in favor of overhead transmission, which extended during 1914 over 3233 miles, while there were in existence only 80 miles of underground cables.

Electrical enterprise and power development had been extremely active in Australia before the war, but since that time progress has been slower, apparently because of the general contraction of capital. Lack of suitable shipping facilities made it difficult for Australia to dispose of its foodstuffs and raw materials in the world's market. The result was a general desire to save on the part of municipalities and the government, both of which are responsible for the extension of electric enterprise. On the other hand, the causes that led to a decline in expansion have added to a general activity in the industry itself. With Australia receiving less goods from abroad, the home industry was compelled to make up the loss. New machinery was introduced, and with the machinery new manufacturing methods, which resulted in a greater consumption of electric power. Also, the electrochemical industry, which was much benefited by the war, increased the demand on the power resources of the country.

The yearly report of the Melbourne Electrical Supply Co. is generally regarded as an index of the state of the electrical industry of the Dominion. The following figures, therefore, are of interest: During the year 1915 to 1916 this company had an increase of 20 per cent. in the number of consumers. The power supply rose 15 per cent., the total connections 22 per cent., and the number of units sold 36 per cent. above that of the year before. The gross revenue was 24 per cent. higher than that of the preceding year.

Similar indications of great prosperity in the electrical industry of Australia may be found in the reports of many other undertakings; but the character of the electrical materials imported shows clearly the direction the electrical business has taken during recent years. During the years 1915 and 1916, for instance, the State of New South Wales received from the United States the following electrical machines and supplies:

	1915	1916
Dynamos	$317,252	$324,031
Switches	92,648	50,110
Heating and cooking apparatus	9,378	9,678
Electroliers	18,361	27,115
Regulating, starting, and controlling apparatus	150,715	96,000
Telephones	180,303	305,319
Accumulators	47,269	13,880
Arc lamps	21,544	15,041
Cables	15,612	28,934
Miscellaneous	1,976	26,969

It will be noticed that the demand has run rather in favor of material for extension purposes than materials for new installations.

In the meantime, however, interest in future electrical development in Australia is far from waning. Good progress has been made in charting and developing the existing natural power resources. In this respect Tasmania has been especially active. Theoretically the Island of Tasmania seems to offer great possibilities for hydro-electric development, but in practice the situation is not quite so favorable. The many small and large rivers which form important falls are not water carriers during the whole year. They lose much of their force during the dry season, and successful hydro-electric development becomes possible only where the flow of the river can be supplemented by the use of artificial or natural reservoirs. Such locations are few on the island, and where they exist they are not situated within easy access of the centers that would be most benefited by them. Even the big natural reservoir which is now used for hydro-electric power generation on a large scale is far removed from its principal consumer, the City of Hobart and the surrounding district.

The so-called Great Lake of Tasmania lies in the center of the island at an altitude of 3350 ft. above sea level. It has an area of 42 square miles and draws its water from a watershed covering 200 square miles or more. During at least six months of the year this region has a comparatively heavy fall of rain, which, if retained, guarantees to the rivers flowing out of the lake a sufficient surplus of water to eliminate the danger of their becoming useless for power generation during the dry months. Here, with the help of a dam conserving the waters of the lake, is in operation the government hydro-electric plant, which serves Hobart and other cities of Tasmania with electric light and power. The dam is run across the southern end of the Great Lake, and the waters are led by the existing river bed to a second reservoir from which pipe lines feed the turbines.

Government Assists Development in Tasmania

The Great Lake region is not easily accessible, and much time, labor and money were lost in transporting materials and machinery to the building grounds. So it happened that the capital provided by the promoters proved to be insufficient, and the work was in danger of being discontinued, as it was impossible at the time to get additional capital. So the government of Tasmania, unwilling to let lapse a project which, when completed, would benefit the whole country materially, stepped in and undertook to finish the scheme under an agreement with the former owners.

After the government took hold, the work progressed very rapidly. The station finally was opened during 1916 with an initial development of 10,000 hp. of the 100,000 hp. which is expected to be available. The result of the opening has been that most of the cities in proximity to the station either have given up their own power enterprises or have connected their stations with the government scheme.

The City of Hobart has entered into an agreement which secures to the city at least 1,500,000 units per annum, to be used for municipal and private purposes. The city pays a minimum price for the power consumed and undertakes to do everything in its power to increase the sale and use of electrical power within its limits. The government reserves the right to deal directly with consumers that buy more than 500 hp. The government also bought the existing generating plant of the city, to be used in an emergency, and it is stipulated that the city shall have the first call on the power generated in this station, should the occasion arise.

Electric Power for Mining Companies

The government also has made power-supply agreements with several of the large mining and electro-metallurgical enterprises that operate in the island, such as Amalgamated Zinc, Ltd., and the Mount Lyell Co. Beginning with the first of January of the present year, the government agrees to supply Amalgamated Zinc with 4000 hp., and within two years that company agrees to take 26,000 additional horsepower at a price of $300,000 per year for the 30,000 hp. It also has a call for 20,000 hp., which need not be taken from the Great Lake development. Under a similar agreement the Mount Lyell Co. will receive 50,000 hp. The extension of the plant for the purpose of supplying these additional demands is already under way, and during the spring of last year $855,000 was voted by the Tasmanian government for the further development of the site.

There has been some dissatisfaction among Tasmanian manufacturers over the government's action in distributing the vast power resources of the Great Lake to big industrial enterprises, and so there has been an extension of surveys made in the island for other sites likely to be used for power development. As a result the following new developments have been proposed: A development of 10,000 hp. can be obtained on Lake Rolleston, near Zeehan. There are several prospective sites on the Franklin River. The Great Lake region contains, apart from the big development described, a possible development of at least 40,000 hp. on the Derwent River, which would have to be worked in conjunction with the lake. From 40,000 to 50,000 hp. may be obtained on the Arthur Lakes.

In the meantime work has begun on the Mount Lyell development on King River. Here a dam 120 ft. high across a narrow gorge forms a reservoir of 3½ square miles, sufficient to generate 30,000 hp. The water is carried in pipe lines to the power station, which will be operated by the government and will be used principally to furnish current for the electrical treatment of zinc ores.

Hydro-Electric Tendencies in New Zealand

The present tendency of hydro-electric development in New Zealand probably is best characterized by quoting from the report of U. S. Consul Alfred A. Winslow, of Auckland. This report says: "Much preliminary work is being done on proposed public works, such as extensive harbor improvements at several ports, hydro-electric plants and new railway developments on North Island, many new public buildings and extensive road building to open up new sections of the country. The government hydro-electric plant at Lake Coleridge, about 70 miles west of Christchurch, was opened during the year with splendid results for Christchurch and vicinity. The city is now lighted by electricity, the tramcars are operated with power from this source, and many of the industries in and about the city secure their power from this plant, at very low rates in all cases. There is a demand for more current than can be supplied by the present installation of 6000 hp., and it is proposed to put in another unit of equal power. The Minister of Public Works has announced that progress was made on the preliminary work for government hydro-electric development in the North Island and that the work will progress until completed, with a view to developing the scheme as soon as conditions warrant."

These preparations in the meantime have developed rapidly, and they show that a great number of sites will be available for hydro-electric purposes in the island. The most promising are the following: A large development able to produce 120,000 hp. on a 50 per cent. load-factor basis at the Arapuni Gorge, eight miles from Hira Hira. Of this total, 30,000 hp. could be developed at a cost of $6,000,000. This would be sufficient to cover the present demand for power from Auckland and surrounding districts. The most suitable source

of power supply for the City of Wellington is the Mangahao River, where approximately 50,000 hp. would be available. If this should not be sufficient, there is another site in the Taranaki district offering good facilities. The Hawkes Bay district, finally, could draw its power supply from Lake Waikaramoana.

The scheme of power development proposed by Evan Parry, the chief electrical engineer of the Public Works Department, is very far-reaching. It not only provides for an early development of the principal sites available, but it contemplates also to link up these sites. This would add materially to the security of the output and would guarantee to the whole North Island a continuous source of cheap power probably not to be found in any other territory of the same extent in the whole world.

The Wellington scheme utilizing the waters of the Mangahao River provides for an interesting engineering feat, as it will be necessary to cut a tunnel through the mountain range separating that river from the Tokomaru River With the help of this tunnel the waters of the latter river will be fed to the Mangahao. The power station will be situated on the Mangahao, within easy reach of the railroad, so that material can be transported to the site without much difficulty. To develop 25,000 hp. in this locality will cost approximately $2,100,000. To this will have to be added the cost of providing the trunk lines and other installation necessary for power distribution to the district, which is estimated at approximately $2,900,000, bringing the cost of the scheme to $5,000,000 in all. Trunk lines will be run from the central generating station to Wellington, Palmerston North, Wanganui, and Masterton as chief distributing centers. The power will be sold to the municipalities in bulk for distribution to small consumers, and the larger consumers will be supplied by the government.

The enterprise shown by the New Zealand government doubtless has been stimulated very much by the great success of the Lake Coleridge development, the opening of which took place during 1916. The Christchurch municipality says in its yearly report that the development has proved an unqualified success, and a governmental report dealing with the same subject points out that the effect of the new power source was evidenced immediately by a great activity in all industries.

The original development of the Lake Coleridge scheme provided for 6000 hp., but during the erection of the plant it became apparent that this would not be sufficient to meet the large demand, and it was finally decided to add another unit of 2000 hp. to the three already existing. During the first year of operation a fifth unit of 4000 hp. was added. The plant earned enough during the first year of operation to pay for its running expenses, and satisfactory progress has been made since then. R. A. Lundquist, the United States Commercial Agent, who recently visited New Zealand, says that the Lake Coleridge power plant ultimately will supply a territory 75 to 100 miles north and south of Christchurch.

The future of the electrical-power situation in New Zealand will depend largely upon the success of the present undertakings. As in Australia, hydro-electric development in New Zealand is a prerogative of the government under a law passed in 1887 and extended in 1908. Under this law there are in operation at present 111 electrical undertakings, 10 of which refer to tramway systems.

The present tendency all over Australia and New Zealand is to make use as much as possible of the hydro-electric powers available in preference to all other kinds of power. The demand, however, has not grown to such an extent that hydro-electric generation can be used to advantage in all locations. The result is that there is still a very extensive demand for steam turbines and engines. The fact that coal can be obtained at a fairly low rate gives steam generation a decided advantage over gas and the internal-combustion oil motor. According to R. A. Lundquist, there will be a demand, as far as New Zealand is concerned, for steam turbines in units of about 500 to 600 hp. for central stations. Below that horsepower steam engines will be favored for the present.

Bonus Plan for Boiler-Plant Operatives

By HAYLETT O'NEILL

The author proposes a bonus plan whereby the firemen, boiler cleaners and fire cleaners may share in the saving effected by close attention to operation and maintenance of the boiler-room equipment. Numerous charts are given to readily check up performance of the boilers, efficiency being rapidly estimated on CO_2 content of flue gases and temperature of uptake gases.

THE principal argument for a boiler-room bonus plan is that such a system, in stimulating efficiency and thereby resulting in the workman getting part of the money that otherwise would go to the coal dealer, makes employer and employee partners for each other's benefit.

The extraction of heat from fuel to generate steam is a complicated process. Some of the factors of waste and efficiency are inherent by nature in the fuel, atmospheric conditions, etc., while others are dependent upon the design, operation and upkeep of the furnace and boiler. Ordinarily, a plant using modern stoking equipment should get better results than a hand-fired plant. But unfortunately, the elimination of old equipment comes slowly and the object of a bonus must be to obtain the best results with existing apparatus.

Practically every bonus is estimated from one or both of two measurements: (1) Over-all plant efficiency or money cost of steam production; (2) percentage of CO_2 in the flue gas, an index to the efficiency of firing and maintenance of the boiler settings.

To be of value the first system requires regular and accurate analyses of coal fired, weights of coal fired and water evaporated, etc., and while the over-all efficiency obtained is the final test of plant operation, the system

by itself is faulty in that there is no fixation of responsibility for savings or losses upon the individuals concerned in the various operations. Such a system is proper when its benefits are applied to the chief engineer or chief executive.

The CO_2 system, where the flue gas is accurately sampled for an entire period and analyzed, gets surprising results in many places; but such a system is faulty

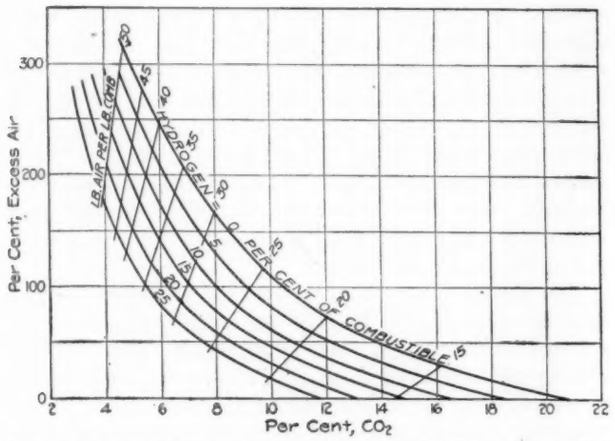


FIG. 1. VARIATION IN EXCESS AIR WITH CO_2 WHEN FUEL IS COMPOSED OF CARBON AND HYDROGEN

in that CO_2 percentage by itself has no relation to the demands on the coal pile. The CO_2 merely measures the degree of air supplied in excess to that theoretically required as a minimum for perfect combustion of a given fuel. Thus, as in Fig. 1, with coal containing about 5 lb. of hydrogen per 100 lb. of combustible, 10 per cent. CO_2 indicates that 23.2 lb. air was supplied

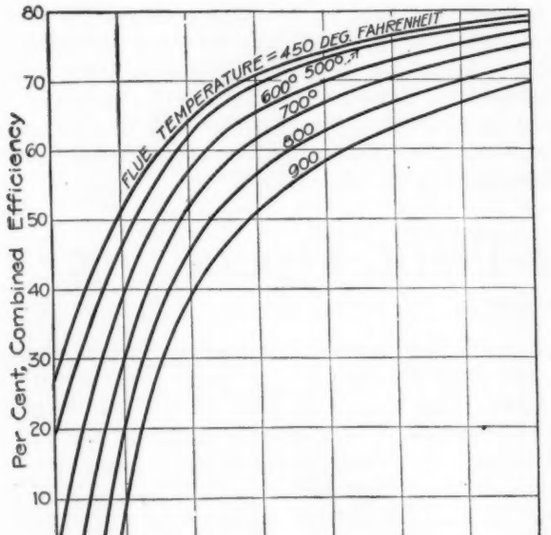


FIG. 2. BOILER EFFICIENCIES ESTIMATED FROM CO_2 AND FLUE TEMPERATURES—EASTERN COALS

per pound of combustible, or 80 per cent. in excess of theoretical requirements.

By far the greatest operating loss in a boiler and furnace is that loss of heat which escapes in the flue gas, and this heat is measured by the weight of gas and its temperature. Consequently, a knowledge of flue temperature is essential to the measurement of boiler-room losses. These two measurements can be made to accurately indicate the total losses.

Fig. 2 shows the calculated combined boiler and furnace efficiency in terms of CO_2 and flue temperature.

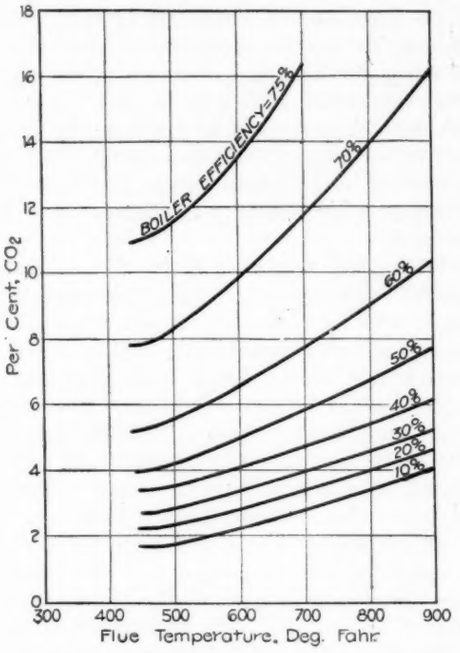


FIG. 3. RELATION BETWEEN CO_2 AND FLUE TEMPERATURES FOR CONSTANT BOILER EFFICIENCY

The values are calculated with certain operating conditions, actually variable, assumed as constant, when the samples of gas and temperatures are accurately taken and averaged over a given period. There will be found a remarkable agreement with actual efficiencies as de-

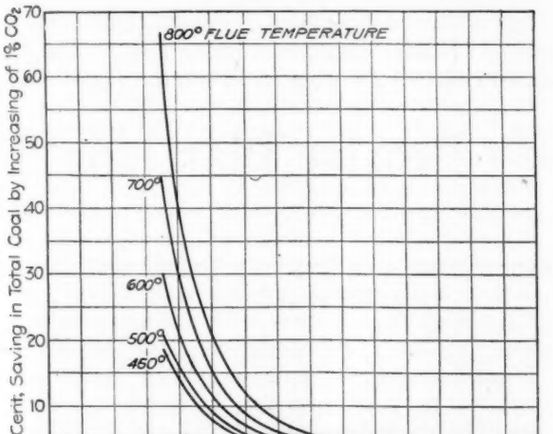


FIG. 4. SAVING IN COAL FOR CONSTANT EVAPORATION BY INCREASING CO_2

termined in the usual approved manner. That is to say, if the average CO_2 and flue temperature were respectively 10 per cent. and 600 deg. F., the average combined boiler and furnace efficiency would be 70 per cent. within 1 or 2 per cent. above or below.

Fig. 3 shows more clearly the same values, but with CO_2 and flue temperature plotted against each other for fixed combined boiler and furnace efficiencies: That is, with 8 per cent. CO_2 there would be the same boiler efficiencies as with 14 per cent. CO_2; or 70 per cent., if the flue temperatures were respectively 480 deg. F. and 810 deg. F. If a fireman by careful firing produced 14 per cent. CO_2, and the boiler-cleaning and repair crew allowed the boiler to become dirty, the baffles to deteriorate, etc., the net benefit to the plant would be nil. In fact it is evident from the chart that it is possible to increase the CO_2 percentage and still have a net plant loss. In Fig. 2 a flue temperature of 600 deg. and a CO_2 percentage of 10 per cent. indicate a combined boiler and furnace efficiency of 70 per cent. By increasing the CO_2 to 12 per cent., but permitting the condition of the boiler to become so bad as to result in an 800-deg. flue temperature, the efficiency will fall to about 67 per cent., with a net fuel loss of over 4 per cent.

Nearly all CO_2 bonus systems allow a fixed sum of money for each increase in CO_2 above a standard. The operating results may work out all right in the end, but there is a danger in the workman's not sharing in true proportion to his saving. That is, the percentage of fuel saving per CO_2 percentage increase is variable, depending upon the percentage of CO_2 and flue temperature. A fixed bonus rate results in the workman's receiving less than he is entitled to under certain conditions, and more under other conditions. For a plant run at high rating or with poor heating surface, the importance of high CO_2 percentage is greatest. There is a greater gain from boosting low CO_2 than from boosting high CO_2. That is, in Fig. 4, with 600 deg. flue temperature, a gain in CO_2 from 9 per cent. to 10 per cent. will save 3 per cent. coal, while a gain from 4 per cent. to 5 per cent. will save 20.5 per cent. coal. This explains the almost incredible savings that can be made in a poorly fired plant, with only a slightly increased effort by the management and the workmen. It is easy to make big savings in a poorly operated plant; but the savings become increasingly hard as perfection is approached.

Although there is theoretically a gain in increasing CO_2 up to a point of zero excess air, 18 per cent. to 19 per cent. for soft coal, there is probably no practical gain in going beyond 16 per cent. Engineers are not agreed upon this point because of the difficulty of getting sufficient accurate data, but it may be said that the gain would be next to nothing.

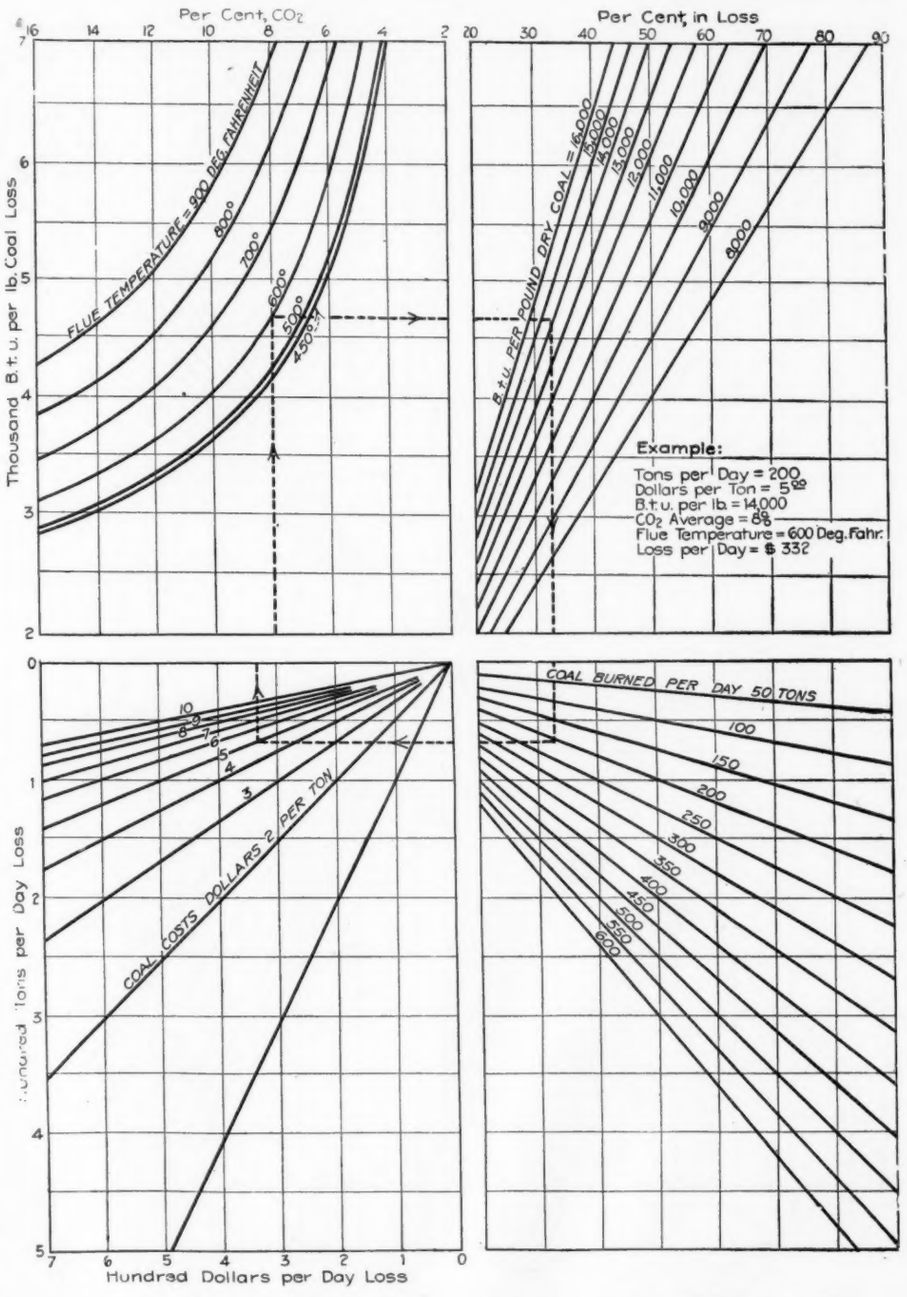


FIG. 5. FUEL LOSSES MEASURED BY CO_2 AND FLUE TEMPERATURES

Thus a bonus system based on a fixed payment per percentage increase of CO_2 and planned to give to the workman a reasonable percentage of the savings made by improving poor operation may bring as large bonuses to the workman as the total saving to the plant, when top-notch results are obtained, in which case further improvement results in a loss to the owner.

The proposed bonus scheme is to pay a bonus to each of three classes—firemen, boiler cleaners and fire cleaners—who are respectively responsible for performances measured by CO_2, flue temperature and percentage of combustible in refuse, each of which values determines the bonus. Actually, the three classes may be vested in one man or several, in which case the bonuses

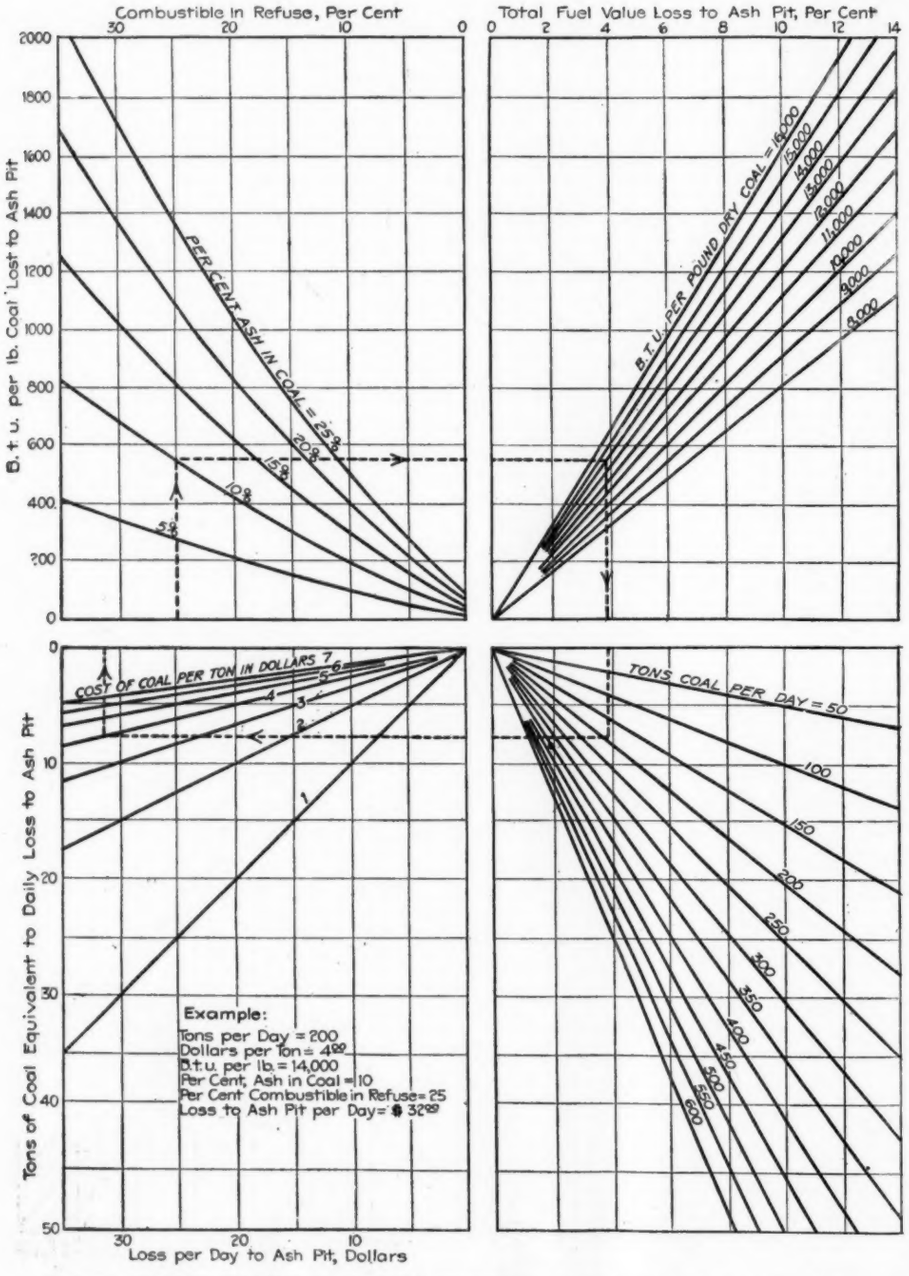


FIG. 6. BOILER-ROOM LOSS CHART, SHOWING FUEL LOSSES TO THE ASHPIT

are to be calculated in the same way, but payment is to be made according to responsibility. In a one-man plant one man would get three bonuses, etc. Each bonus is to be a fixed percentage of the fuel saving measured by CO_2, flue temperature and percentage combustible in refuse, for results better than those measured by standard CO_2, flue temperature and percentage combustible in refuse. Thus there will always be a fixed ratio between profits of workmen and owner, which is desirable.

Ordinarily, CO_2 depends upon the quality of firing, but it also is dependent upon the condition of the boiler setting and of the grates over which the fireman, as such, has no direct control. On the other hand, a good fireman would not allow himself to be deprived of the fruit of his efforts because of a poor setting or of poor grate. Knowing that such defects in the apparatus lead to unnecessary excess air, if the maintenance man fails to do his duty, the fireman naturally will report defects of apparatus to the chief for proper action.

The maintenance man or boiler cleaner can save money by keeping the boiler clean and the baffles in such shape that the boiler will readily absorb heat, so that the flue temperature will be low. An unscrupulous repairman may wilfully neglect the setting and grates in order to admit excess air to cool flue gas so as to increase his bonus. But such a condition would naturally be opposed by an active fireman.

It is true that the flue temperature is dependent not only upon the condition of the apparatus, but also upon the rate at which the fuel is fired. Even in the most efficiently designed installation the percentage of total heat absorbable falls off as the boiler rating increases and the flue temperature rises with increase of load. Therefore it is necessary to base the standard flue temperature for an average load by test. This is comparatively simple for industrial plants where the load is rather steady.

Fig. 5 shows the daily losses in dollars and cents based on the efficiency charts, for any condition measured by CO_2 and flue temperature. That is, under the conditions for the plant illustrated, the daily loss would be $332. Loss from combustible in ashpit refuse is primarily up to the fire cleaner, who may be a special man or the regular fireman. In case the loss is great owing to poor condition of grates, the fire cleaner, whose interest is thereby prejudiced, should report conditions to the chief for proper action.

The losses on account of combustible in the refuse are measured not only by the percentage of combustible in the refuse, but also by the percentage of gas in the coal. Twenty per cent. combustible in refuse of coal contain-

ing 5 per cent. ash means a loss of 205 B.t.u. per pound of coal, while the same percentage of combustible in refuse of coal containing 25 per cent. ash means a 1023-B.t.u. loss per pound of coal.

Fig. 6 shows the daily losses in dollars and cents for any condition measured by percentage of combustible in the refuse and percentage of ash in the coal. That

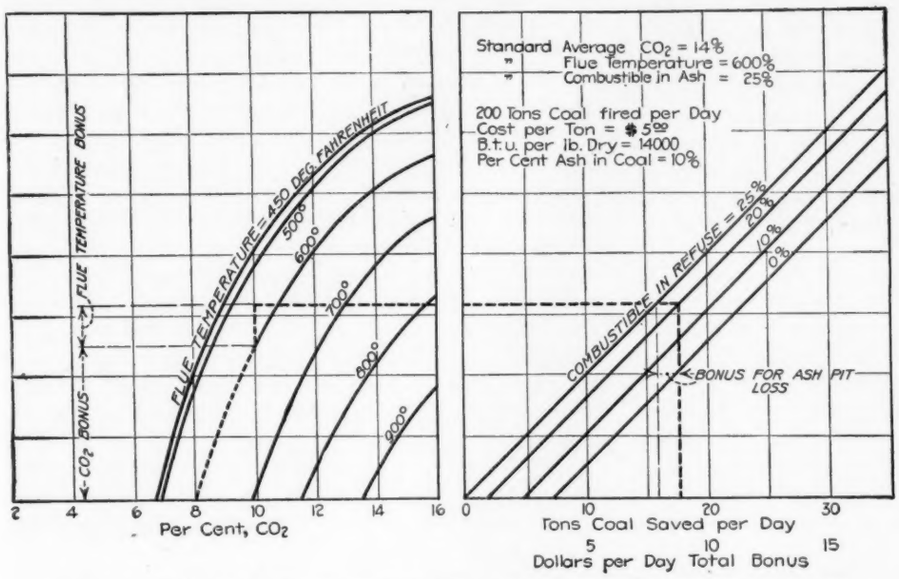


FIG. 7. CHART TO DETERMINE BONUS FOR BOILER PLANT OPERATIVES

is, under the conditions of the plant illustrated, the daily loss is $32.

Fig. 7 shows a bonus chart with assumed conditions as to quality, quantity and price of coal, with bonus equal to 10 per cent. of the savings calculated from the efficiency chart, to be made by obtaining results better than those measured by the standards of 8 per cent CO_2, 600 deg. flue temperature, 25 per cent. combustible in ash.

Assuming the following average attained:

CO_2, per cent	10
Flue temperature, deg. F	550
Combustible in refuse, per cent	20

the daily bonus per day equals:

To firemen	$6.10
To boiler cleaners and maintenance men	1.80
To fire cleaners	1.00
	$8.90

The division of the bonuses to individual men is left to the judgment of the management. In the example given, it may be advisable to increase the bonus to boiler cleaners to $3.60 per day, in which case the bonus would be equal to 20 per cent. of this saving to the plant.

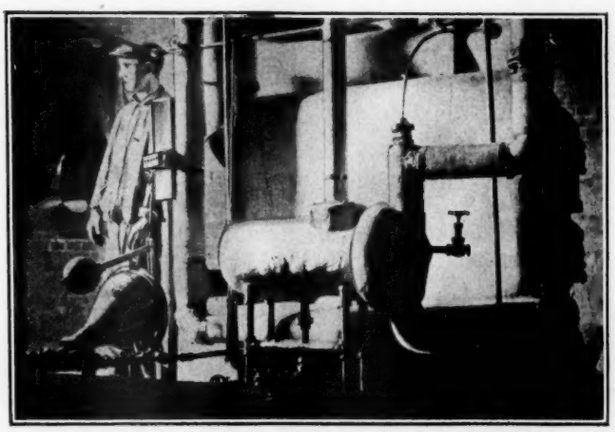
Steam To Heat Water for House Heating

BY P. J. BRYANT

The use of steam to heat water is not uncommon, but as to the economy of the transfer of the heat from steam to water there seems to be a scarcity of data at hand. We have such an installation at the institution where I am employed, and our operating experiences may be of interest to others. The large buildings are all heated by steam furnished from a central power plant through tunnels, but residences have individual heating systems in their basements. The chaplain's cottage is heated by hot water heated by steam from the tunnel steam main, and the illustration shows a tilting trap to which a tally is attached to meter the condensation during a test of the steam required to heat the cottage.

The heater, also shown, is 32 in. long and 14 in. in diameter, having 16 sq.ft. of heating surface, and the water circulates through the tubes by the thermo-siphon principle. High - pressure steam is delivered through a reducing valve at 2 lb. pressure, controlled by a temperature-regulating valve, so that the water in the system may be maintained at any predetermined temperature. Ordinarily, the condensation from the heater returns to the tunnel system through a seal, but in order to obtain operating data, the calibrated tilting trap with a counter attached, was installed temporarily and all the condensate during the month of February passed through this improvised meter. Daily readings of the counter were taken, and the daily consumption of steam, in pounds of condensation, was plotted for the month against the daily outside temperatures and, although the consumption varied inversely as the temperature change, there was no definite ratio. This is accounted for by variable winds as well as bright or cloudy days, snow, etc. Following is the result: February, 1917, average outside temperature, 25.2 deg.; pounds condensate for the month, 58,270; per day, 2081; cost per month at 20c. per thousand pounds, $11.65; day, $0.416. The cost of steam, 20c. per thousand pounds, was figured from the cost of evaporation at the power plant.

The convenience and flexibility of such a system are at once apparent.



TALLY COUNTER ATTACHED TO STEAM TRAP

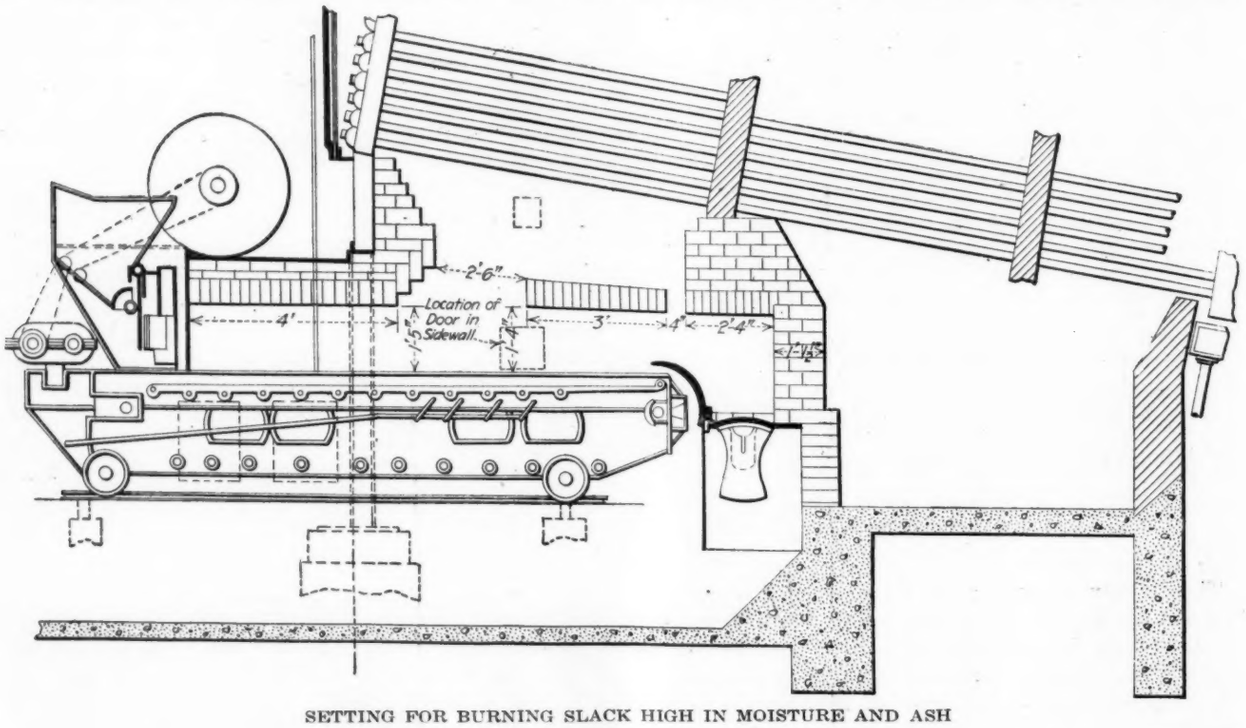
Burning Slack Containing Excessive Moisture

By J. F. McCALL
Superintendent and Chief Engineer, Municipal Power Plant, Calgary, Alberta, Canada

The author burns Drumheller (Alberta, Can.) slack coal, averaging 15 per cent. moisture and 12 per cent. ash on a chain-grate stoker with an arch over the entire grate except for a space 2 ft. 6 in. deep, and the width of the grate long. The long deflection arch extending forward 3 ft. from the brige-wall rolls the flame of the 30 per cent. volatile coal forward far enough to evaporate the moisture as the coal comes on the grate from the feed hopper, avoiding caking of the coal at the rear of the grate.

THERE is sufficient coal in the province of Alberta to supply the whole of the North American Continent for several centuries. The quality varies considerably from surface lignite to the excellent coking coal at Fernie and the valuable semi-anthracite in the Banff district. The known deposits extend over an enormous area, from the Peace River district in the north to the international boundary, and from Medicine Hat to the Rockies. Supplies are sent as far east as Regina, Saskatoon and Winnipeg; the hard coal at Banff finds its way to the coast, and the coke product of the south is extensively used in the smelters across the border. Freight rates, however, govern the extent of the market, the local requirements do not begin to absorb the possible output, and the greater part of the field lies undeveloped. A few years ago a new district, known as the Drumheller field, was opened, and immediately became a factor in the market. This coal was found to average around 11,500 B.t.u. on analysis, but contains excessive moisture, frequently over 15 per cent. I tried the Drumheller slack coal several times on our 335-hp. water-tube boilers with chain-grate stokers, invariably with very unsatisfactory results. It was impossible, owing to the excessive moisture, to ignite the coal sufficiently until it had passed about three feet into the furnace. This was the more disappointing as the freight rate from the Drumheller district was from 20 to 40c. per ton cheaper than the rate on the supply we were using, and in the class of coal we burn the freight is usually the larger item. This, however, did not affect us as much as it did the power plants at Saskatoon and some other towns and cities north of Calgary, all of which have the Drumheller field between them and the field south of Calgary, their freight rates in that case being more than double ours and their cost of production correspondingly higher. Their difficulty in burning the Drumheller coal was the same as we experienced.

Early in 1917 I learned that experiments were being made in Edmonton and Saskatoon with a view to burning the Drumheller coal, the idea being to dissolve the moisture immediately the coal reached the furnace grate. To find out what they were doing and to get some ideas for myself, I went to both places, and found that taking into consideration their higher costs for fuel as compared with ours, the Saskatoon and Edmonton plants had been fairly successful in burning the Drumheller coal. I was satisfied, however, that the arrangement made there of the furnace grate could be improved upon, and we made alterations to eight of our 335-hp. boilers, and eventually evolved the idea represented in the drawing. The chief feature is the center deflecting



SETTING FOR BURNING SLACK HIGH IN MOISTURE AND ASH

arch, which deflects the flame from the burning coal to the front of the furnace and thereby ignites the fresh coal as it enters the grate. This flame evaporates all moisture, and the result is an intense heat evenly distributed. We have no trouble in getting 110 per cent. overload out of these boilers, and can burn anything which has anything in it to burn. We have been successfully burning coal with 22½ per cent. of moisture, so that we are able to use freely the slack from the Drumheller field.

We found it necessary to remove an 18-in. sector of the stoker (Babcock & Wilcox chain-grate) casing, to move the bridge-wall back to correspond, so that we could put the stoker back. We considered that it would be desirable to allow an ignition space of 18 in. below the hopper. Ignition takes place at from 8 to 12 in. The reason for the opening at the rear arch is that we found that the fuel on the grate showed a tendency to bank at the end of the grate and that this bank was rich in combustibles. By arranging the opening, a strong draft was created at this point and we were able to burn the carbon out of this bank. In our earlier alterations we allowed only a 4-in. space, but later we found a 6-in. space gave better results. A trial of an 8-in. space proved unsatisfactory. Much depends on the available draft. We used a 0.3-in. draft.

It will be understood that these boilers are equipped with chain-grate stokers of the close-link type. To find out how the arrangement of arches would work with other kinds of stokers or in hand-fired boilers must be a matter of experiment.

In September last we made several tests on the Drumheller coal. In each case the boiler was fired for 24 hours. The test lasted for 10 hours, the object being to test the coal and to obtain working results from the boilers under the new arch arrangement. The following is an average result:

Average pressure, gage, lb. per sq.in.	149
Average draft (at furnace), water, in.	0.31
Average temperature, steam (saturated), deg. F.	364.6
Average temperature, steam (superheated), deg. F.	512
Average temperature, flue gas, second pass, deg. F.	690
Average temperature, flue gas at damper, deg. F.	487
Average temperature water (at heater), deg. F.	116
Average CO_2, per cent	11.33
Builder's rating, hp.	335
Horsepower developed	458
Percentage of builder's rating	136.7
Water evaporated per pound of coal as fired, lb.	6.65
Equivalent evaporation per pound of coal as fired, lb.	8.02
Stoker speed, average, ft. per min.	2
Thickness of fire, in.	4

On analysis these coals from the Drumheller mines are quite uniform. The following is an analysis of an average sample:

Moisture, per cent	15.04
Ash, per cent	12.18
Volatile combustible, per cent	29.95
Fixed carbon, per cent	42.47
B.t.u.	11,450

In view of the present shortage of coal these successful experiments will probably prove of interest. It is possible, under the conditions enumerated, to burn any fuel that has anything in it to burn, and it would be quite possible to utilize dumps of wet slack coal which lie at the mouth of coal mines all over the continent, rejected as being useless on account of the moisture content, the accumulation of long periods of exposure to the weather. It is quite reasonable to suppose that there are large quantities of fuels of this class which owners of boiler plants are at present unable to use, in some cases hauling their coal from a distance when they have a suitable fuel close at hand.

Sarco Metallic Gaskets

Lead would make a good gasket with high-pressure steam if it were not so liable to blow out. A lead gasket, being soft, fits into any depression in the flange and gives way for any protruding surface. A copper ring gasket makes a good joint, but being harder than lead, does not conform to the surface of the joint so readily.

A combination of a lead and a copper gasket has been devised by the Sarco Co., Woolworth Building, New York City. It is made for various purposes and in different forms. For flange work, Fig. 1, the lead ring *A* forms the inner member, and just fitting over the outer edge is a copper ring *B* of smaller cross-section. This is to permit the lead ring to come under considerable pressure in tightening up the joints before the flange begins to compress the outer copper ring.

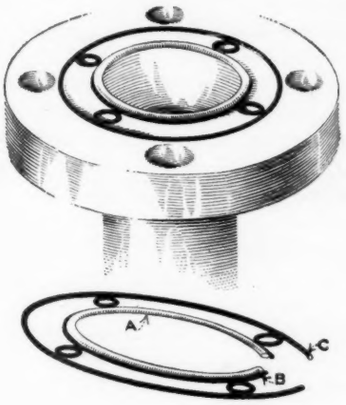


FIG. 1. GASKET FOR WIDE-FACED PIPE FLANGE

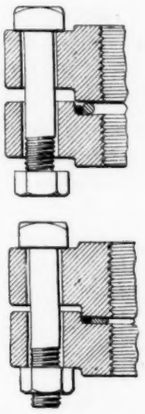


FIG. 2. BEFORE AND AFTER COMPRESSION

With this type of gasket the copper and lead elements, *A* and *B*, are surrounded by a centering ring *C*, the outer diameter of which is a trifle less than the diameter of the circle on which the inner edge of the bolt holes line; thus the bolts, when fitted into place, center the gasket. The centering ring *C* is held concentric with the gasket rings by small copper circles, all members of the gasket being lightly soldered to form a complete unit.

For union connections, where the coupling surfaces to be sealed are relatively narrow, the gasket is composed of a lead and a copper ring lightly soldered together at intervals. The application of the gasket is shown in Fig. 2, which also shows the gasket before and after the joint is tightened. The inner lead ring is of greater cross-section than the copper one and squeezes out into a ribbon form under pressure. The slightly compressed copper ring backs it solidly and prevents the lead ring from blowing out when it is under pressure.

A gasket for superheated steam above the safe working point for lead is made of a number of soft concentric copper rings. For joints the gaskets of which are subject to corrosive fluids from the outside the copper ring is surrounded by a lead one, which, as the gasket is compressed, forms an effective shield against the access of foreign matter. These gaskets are made in various sizes.

The Central-Station and Isolated-Plant Controversy

THE continuation of the hearing before the Public Service Commission for the First District of New York on Mar. 11 was taken up principally with an investigation of the relations between the New York Service Co. and the New York Edison Co. According to the testimony of several witnesses, the New York Service Co. is a company that undertakes the management and operation of isolated plants. In a number of instances the salesmen of the Edison company had suggested to prospective customers the advisability of discontinuing the private-plant generation of electricity and the purchase of current from the Edison company, at the same time allowing the New York Service Co. to operate the steam plant. The case of the Hotel Majestic, mentioned at the hearing of Mar. 4, was an instance of this sort of arrangement.

The purpose of the hearing at the outset was to investigate the service, facilities and rates of electrical corporations with regard to furnishing current for breakdown or auxiliary use, and for buildings having private electric plants. The interest of the Fuel Administration and the controversy between the private plant and the central station are matters that developed naturally from statements made at the first hearing in the case.

It had been suggested that if isolated plants could be supplied with current from the central station during those periods in which the isolated plants had no use for the exhaust steam from their engines, it would be possible to shut down those plants and save a considerable amount of fuel. It was pointed out that the additional burden thus thrown upon the central station would be in the nature of an off-peak load.

At the hearing on Mar. 11, John W. Lieb, of the New York Edison Co., made the emphatic statement that on Manhattan Island, and under Manhattan Island conditions, there was no such thing as off-peak service. To substantiate this assertion, he produced two load curves, one for Dec. 12, 1917, and the other for June 5, 1917. The former represented the maximum load for the year 1917, which was 234,736 kw. The latter showed a maximum load of 200,000 kw., due to a very sudden thunderstorm. The point Mr. Lieb sought to bring out was that during the summer—when the isolated plants would wish to use the suggested off-peak service—the Edison company was likely to be subjected to a demand for current equal to the capacity of the plant, and that at very short notice. From this he argued that an off-peak condition did not exist.

At the same hearing, Charles E. Stuart, representing the Conservation Division of the Fuel Administration at Washington, asked permission to read into the record a statement defining the position of the Fuel Administration in the matter of coal conservation by manufacturers of electric current. In part, his statement was as follows:

> The individualistic way in which fuel is now consumed in cities is not efficient. A ton of coal burned in a large central station will produce at least four times as much electric power as if burned in the average small plant, and if centralized burning could be introduced to a greater extent, the amount of fuel required could be largely reduced without reducing in any way the ultimate production of light and power.
>
> It may be generally stated that in buildings where electric plants are located and where exhaust steam from engines is utilized in the heating of the building, furnishing hot-water requirements, and possibly providing a very small amount of steam for industrial and other processes, such buildings can readily adopt central-station service without a loss of money and at a large percentage of saving in fuel.
>
> In many other cases it might be more economical from the viewpoint of fuel saving to utilize isolated electric plants in conjunction with central-station service. The ideal arrangement would then be to use the combination of services in such a way that no exhaust steam is sent to the atmosphere to be lost.
>
> It is the duty of the Fuel Administration to devise means for securing a curtailment in the use of fuel in ways which will impose a minimum of hardship. It is believed that there are many plants not only in New York, but throughout the entire country, which could, at least temporarily, shut down their own electrical machinery and purchase power from others at a financial advantage to both parties and with a considerable saving in fuel.
>
> The Fuel Administration believes that if even a comparatively small proportion of the plants throughout the country which could save fuel in this way at a profit to themselves would do so, it would prove a tremendous help in meeting the fuel situation with which the country is confronted, and in winning the war.
>
> While it may appear that the interests of the central station are being benefited to a large degree, such is not of necessity the case. In some cases, central stations may be shut down. In any event any connection between a central station and a building or a manufacturing plant that is affected, will, of necessity, be for the period of the war only or through the period where the coal situation is critical. The machinery of the isolated plant can be readily preserved through this period of necessity. Under these circumstances the heavy expense attendant upon the making of the connection by the central station may completely or even more than offset any profit which could be expected of such a load through a short period.
>
> At this point another very important question, that of the release of the operatives of the plants, presents itself. In those cases where small electric plants are closed down entirely, there will be a larger number of men available than in cases where a partial closing down is brought about. In any event these skilled men are vitally needed in many of the war industries of this country, and provision is now being made whereby men of such training will be assisted in obtaining profitable work suitable to their ability.
>
> Again, the conservation efforts of the Fuel Administration are being directed in order to conserve the interests of all with the least inconvenience and cost and with the object of making the coal supply that is available go just as far as possible and to prevent the necessity of further drastic measures such as were necessary in January. In this spirit the Fuel Administration invites the coöperation of the isolated plant owner, whether the question be of connecting in on the lines of a central station or whether it be that of operating his plant to maximum efficiency. The alternative will be at least the one if not the other.
>
> The administration at this time has no idea of attempting to bring about any such result by means of orders, or of even suggestions that fuel be saved by the closing of isolated plants where this would cause hardship to the owners, not commensurate with the benefit derived by the public. It is interested in the present hearings, however, in the hope that they will set forth the facts and also the savings which are possible in certain cases in so convincing a way that each plant owner will consider himself a volunteer member of the administration, charged with the duty of investigating his own condition in a nonpartisan way and, where circumstances warrant it, of taking the necessary steps to secure the saving.

The second paragraph of the foregoing statement is of especial interest to the owners of isolated plants in which a small part of the steam generated is used

in producing electric current while the greater part is used for heating, drying, cooking, etc. Its conclusions are diametrically opposed to the results of experience in many instances in which isolated plants discontinued the generation of electric power and adopted central-station service, at the same time continuing to produce steam for heating and other purposes. The testimony of Copeland Townsend, of the Hotel Majestic, at the hearing of Mar. 4, showed that the adoption of such a plan not only failed to save coal, but placed the plant under additional heavy expense.

Mr. Stuart, who issued this statement on behalf of the Fuel Administration, is an electrical engineer and a member of the firm of Stuart, James & Cooke, whose business it was, previous to the war, to investigate power plants with a view to determining whether they could not be supplanted economically by electric power from large central stations. In an interview with the editor of *Power* Mr. Stuart said that his firm had investigated perhaps 800 plants, most of which were connected with mining operations, and that the majority of these eventually changed from individual service to central-station service.

When he was asked whether the statement he had read into the record was an expression of his own individual views, he replied that it represented the consensus of opinion of a number of the Fuel Administration's engineers, himself included; however, he finally admitted that there were numerous small plants, such as those carrying combined heating, power and lighting loads, in which the substitution of central-station service would undoubtedly fail to show a saving of coal.

This is the opinion held by many engineers who have carefully considered the problem. At the January meeting of the American Institute of Electrical Engineers, a paper was presented by Lynn S. Goodman and William B. Jackson on "The Effects of War Conditions on Cost and Quality of Electric Service," in which the authors made the following assertions: "When viewed from every standpoint, it will be seen that the economical central power generating station is the proper medium for the supply of the large power requirements arising on account of the war"; and "these advantages of the central-station power are so large that it is advisable for the Government to use every reasonable means to encourage the central-station companies and discourage individual power plants during the war period."

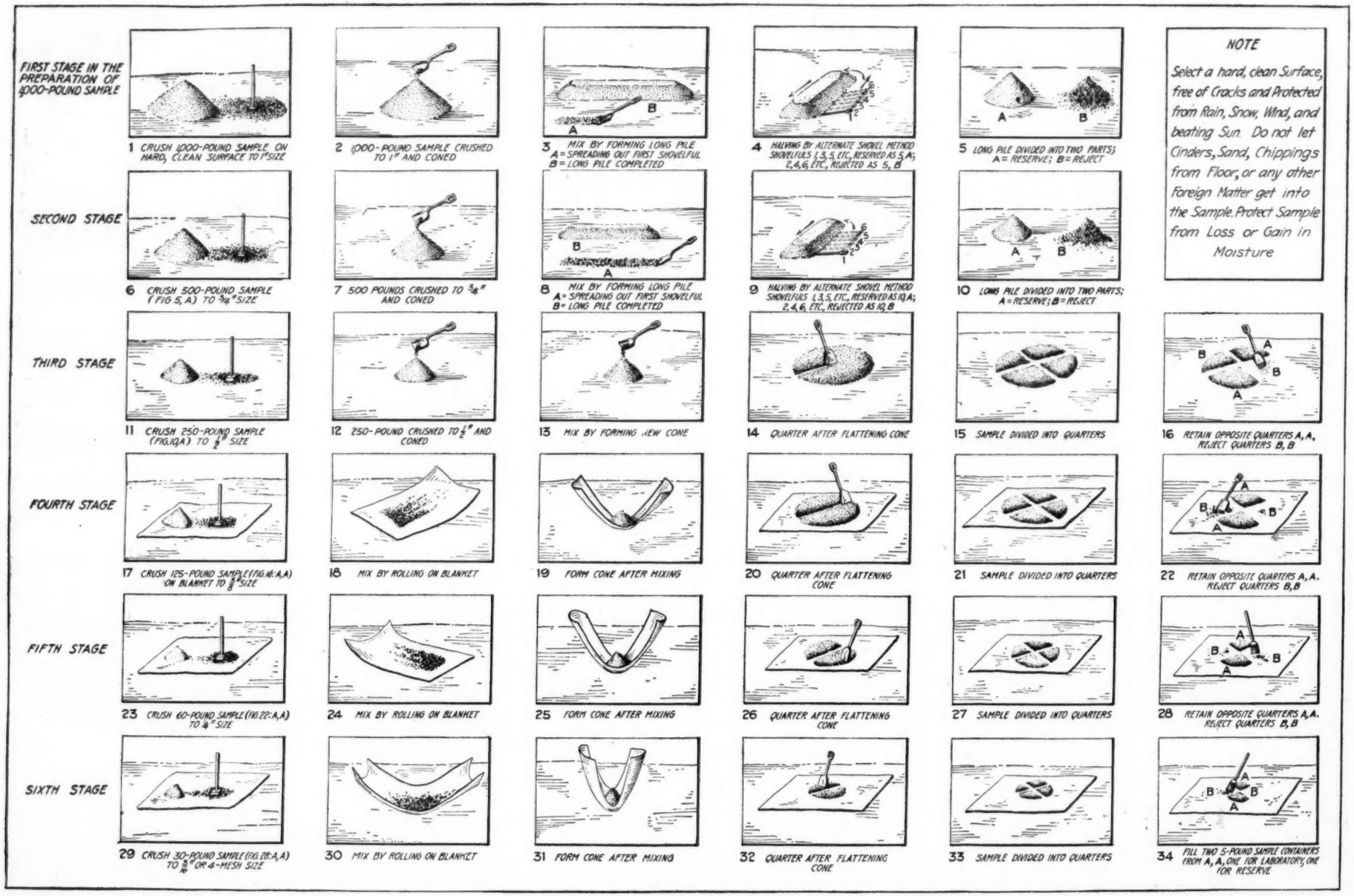
As might have been expected, such sweeping claims as these were not allowed to stand unchallenged. Bion J. Arnold, in discussing the paper, said:

> There is no question in my mind that where you can utilize steam for heating and have some use for that heat aside from merely heating in winter time, there is an advantage in having an isolated plant. For instance, in a hotel, where you need steam for cooking, under such conditions as that the isolated plant, in my judgment, will be superior to the central-station power; that is, it can produce its own heat and electrical energy cheaper than it can buy it from the central station. That is the only instance, in my experience, where I have found that it would work out in that way; otherwise, it is generally cheaper to buy energy from the central station.

The same topic was referred to in the discussion by Mortimer Freund, who said:

> I do not believe it proper to allow to pass unquestioned the authors' statement that "the economical central-power-generating station is the proper medium for the supply of large power requirements arising on account of the war," and further that "it is advisable for the Government to use every reasonable means to encourage the central-station companies and discourage individual power plants during the period of the war." Both of these statements are too sweeping in character and, as a matter of fact, only justifiable for such cases, where a careful and disinterested consideration of all the circumstances will warrant such a conclusion.
>
> It seems to me that the second statement might better be substituted by the following: It is advisable for the Government to encourage all consumers of fuel to use every effort to fulfill their heat, light and power requirements by such means as will utilize fuel most economically and do away with all existing wastes which are preventable.
>
> There are industrial plants, for example, where a great part, if not all, of the electricity used is virtually a by-product due to the utilization of exhaust steam from the electrical generating unit. I have in mind a large industrial plant which up to 1915 operated two separate boiler plants, the output of one of which was utilized almost exclusively for drying. The exhaust steam from the electric generating plant was wasted in the nonheating season and only partly used during the heating season. Substitution of purchased electricity had been suggested. Since 1915 the exhaust steam has been utilized in place of live steam, the use of one of the boiler plants has been discontinued and the actual cost of electricity, in view of the use of the exhaust steam, is far less than the best price which outside service can offer. The action on the part of the management of this mill in undertaking the change necessary to permit of this has not only paid them well on the investments made, but has benefited the country to the extent of reducing their fuel consumption. Surely, the authors do not recommend that the Government discourage such an individual generating plant, although such a conclusion might be drawn from their statements.
>
> I hold no brief for the private power plant. There are unquestionably many private plants now in operation which should be supplanted by central-station service. It has been my own practice to recommend central-station service in all cases excepting those where the installation of a new private power plant or the continuance of an existing plant would show a substantial saving in the cost of operation or other advantages of substantial worth. The private power plant is not an obsolete idea, as some have been trying to tell us. There are cases where it results in the most highly efficient production of heat, light and power. Each case should be decided upon its own merits and not on the basis of sentiment. Sweeping generalities are, in my opinion, unwarranted and misleading.
>
> The central-station service and the private power plant should not be in conflict, especially at the present time. Each has its proper sphere, and conditions may have arisen or will arise in particular instances to cause one service to supplant the other. It has been and will be to the mutual advantage of many central stations and private plants to coöperate by exchanging of service at different times of the day or during different seasons of the year. Friendly consideration and coöperation should exist between central-station management and the management of private power plants, so that maximum efficiency in operation may be maintained and the greatest benefit assured to the general public. This is a policy in keeping with the spirit of the times and necessary for the conservation of our natural resources.

If we help Uncle Sam by buying Liberty Bonds, we help ourselves. The buying of Liberty Bonds resolves itself into an expression of the highest form of intelligent self-interest. A British sergeant told a cocky young American, just off a troopship, "You aren't fightin' to save France, an' you aren't fightin' to save Belgium; you're jolly well fightin' to save your children and your grandchildren." The same line of reasoning applies to the buying of Liberty Bonds, for in the last analysis you aren't buying them to help a mythical old gentleman in a bestarred swallow-tailed coat and striped trousers who is having a lot of trouble purchasing ships and shoes and sealing wax; you're jolly well buying them to help yourself.


FIRST STAGE IN THE PREPARATION OF 4000-POUND SAMPLE
1 CRUSH 4000-POUND SAMPLE ON HARD, CLEAN SURFACE TO 1" SIZE
2 4000-POUND SAMPLE CRUSHED TO 1" AND CONED
3 MIX BY FORMING LONG PILE A = SPREADING OUT FIRST SHOVELFUL B = LONG PILE COMPLETED
4 HALVING BY ALTERNATE SHOVEL METHOD SHOVELFULS 1,3,5, ETC., RESERVED AS 5, A; 2,4,6, ETC., REJECTED AS 5, B
5 LONG PILE DIVIDED INTO TWO PARTS; A = RESERVE; B = REJECT
NOTE
Select a hard, clean Surface, free of Cracks and Protected from Rain, Snow, Wind, and beating Sun. Do not let Cinders, Sand, Chippings from Floor, or any other Foreign Matter get into the Sample. Protect Sample from Loss or Gain in Moisture
SECOND STAGE
6 CRUSH 500-POUND SAMPLE (FIG 5, A) TO 3/4" SIZE
7 500 POUNDS CRUSHED TO 3/4" AND CONED
8 MIX BY FORMING LONG PILE A = SPREADING OUT FIRST SHOVELFUL B = LONG PILE COMPLETED
9 HALVING BY ALTERNATE SHOVEL METHOD SHOVELFULS 1,3,5, ETC., RESERVED AS 10, A; 2,4,6, ETC., REJECTED AS 10, B
10 LONG PILE DIVIDED INTO TWO PARTS; A = RESERVE; B = REJECT
THIRD STAGE
11 CRUSH 250-POUND SAMPLE (FIG. 10, A) TO 1/2" SIZE
12 250-POUND CRUSHED TO 1/2" AND CONED
13 MIX BY FORMING NEW CONE
14 QUARTER AFTER FLATTENING CONE
15 SAMPLE DIVIDED INTO QUARTERS
16 RETAIN OPPOSITE QUARTERS A, A, REJECT QUARTERS B, B
FOURTH STAGE
17 CRUSH 125-POUND SAMPLE (FIG. 16: A, A) ON BLANKET TO 3/8" SIZE
18 MIX BY ROLLING ON BLANKET
19 FORM CONE AFTER MIXING
20 QUARTER AFTER FLATTENING CONE
21 SAMPLE DIVIDED INTO QUARTERS
22 RETAIN OPPOSITE QUARTERS A, A. REJECT QUARTERS B, B
FIFTH STAGE
23 CRUSH 60-POUND SAMPLE (FIG. 22: A, A) TO 1/4" SIZE
24 MIX BY ROLLING ON BLANKET
25 FORM CONE AFTER MIXING
26 QUARTER AFTER FLATTENING CONE
27 SAMPLE DIVIDED INTO QUARTERS
28 RETAIN OPPOSITE QUARTERS A, A. REJECT QUARTERS B, B
SIXTH STAGE
29 CRUSH 30-POUND SAMPLE (FIG. 28: A, A) TO 3/16" OR 4-MESH SIZE
30 MIX BY ROLLING ON BLANKET
31 FORM CONE AFTER MIXING
32 QUARTER AFTER FLATTENING CONE
33 SAMPLE DIVIDED INTO QUARTERS
34 FILL TWO 5-POUND SAMPLE CONTAINERS FROM A, A, ONE FOR LABORATORY, ONE FOR RESERVE

How To Sample Coal With a Shovel, Tamper and Blanket. From Technical Paper 133, Bureau of Mines

Editorials

The Buying Line and the Firing Line

THE Buying Line Over Here and the Firing Line Over There, which our cartoonist has depicted in the foreword of this issue, makes us ask the question, Can there be any comparison? Although the buying of Government securities by those at home is absolutely necessary in order that supplies in a never-ending stream be kept flowing to the boys at the firing line, a comparison between the two is difficult of comprehension.

How many of us at home have made any real sacrifice? True, we have our wheatless days and our meatless days, but so far no eatless days, and whatever restrictions we have made, those of us who have made them, regarding our stomachs, have found it to have a beneficial effect. Therefore, in this respect our sacrifice has not been a hardship at all, but something that we should have done for our own physical well being, war or no war.

Most of us are employed in as congenial or even more congenial vocations than ever before, at better wages than received in pre-war periods and to a very large extent indulging in the same luxuries we always have.

As to buying Liberty Bonds, is this a sacrifice—to invest money in your Government's bonds, a security that is the safest investment in the world at a rate of interest that is as good and in some cases better than can be obtained in a savings bank? This act, even leaving all patriotic motives out of it, is nothing more nor less than a sound common-sense business transaction, in which you are absolutely sure of benefiting yourself financially.

How about the boys on the firing line over there—those who have given up their home and its comforts and all that most of us hold dear, for the life of the trench and the dugout? This is best expressed by the following letter received from Citizen Soldier No. 258, ——th District, National Draft Army. This letter should make every American do more than think. It should make him act.

They say, who have come back from Over There, that at night the troubled earth between the lines is carpeted with pain. They say that Death rides whistling in every wind, and that the very mists are charged with awful torment. They say that of all things spent and squandered there young human life is held least dear. It is not the pleasantest prospect for those of us who yet can feel upon our lips the pressure of our mothers' good-bye kiss. . . . But, please God, our love of life is not so prized as love of right. In this renaissance of our country's valor, we who will edge the wedge of her assault make calm acceptance of its hazards. For us the steel-swept trench, the stiffening cold—weariness, hardship, worse. For you, for whom we go, you millions safe at home—what for you? . . . We shall need food. We shall need care. We shall need clothes for our bodies and weapons for our hands. We shall need terribly and without failure supplies and equipment in a stream that is constant and never-ending. From you, who are our resource and reliance, who are the heart and hope of that humanity for which we smite and strive, must come these things.

For us at home to do our bit isn't enough. Our utmost is mighty little compared to the supreme sacrifice our men are willingly making. We can't all fight, but we can all support the Government. We can all economize and we can invest our savings in Government securities. Remember this war won't be won if we depend on the other fellow to win it. It's up to you. Your bit isn't enough; we must see to it that the Buying Line Over Here is maintained in a way that will make it possible for the boys at the front to make the firing line Over There impregnable. One way of doing this is to buy all the bonds you can of the Third Liberty Loan, to be offered on Apr. 6.

Bandar-Log or Bee?

FROM the time a monkey opens his eyes in the morning until drowsiness overpowers him at night, he is pretty much a law unto himself. He does anything he wants to, when he wants to, and as long as he wants to. A whimsical individualism sums up his philosophy of life. The day's end finds him just where he was in the morning. The tribe—bandar-log, Kipling calls them—respond to any leader of the moment and as quickly quit him to follow another or to fetch up individually with a brand-new, suddenly caught and all-absorbing idea.

Like any other philosophy, it is a charming one if you like the net results of it. The monkey does. On the contrary, the bee doesn't. The bee insists on organization by functions. His philosophy is self-sacrificing, vigorous and stern—a Spartan philosophy applied to production. "Beeficiency" is the Taylor System raised to the nth power; and the bee doesn't get the honey.

If the bee had sense, he'd maintain his present organization a few hours a day—which would easily supply his wants—and be a bit bander-logish the balance of the time. But he cannot. The reason is because he doesn't think. He's a machine that is a part of a bigger machine. On the other hand, if he did think, he'd immediately tend to become individualistic, and the moment that happened the organization would begin to wabble. There would be argument about how the comb should be built, who should build it, who should boss it, how much honey should go to each; societies for the prevention of this and that would be formed. Social workers must eat; so must bosses; so must societies for the prevention of things.

Nature did not see fit to devise a species having the merits of both bandar-log and bee—a sort of bandar-bee.

A bandar-bee would help us a lot just now. It would be the real super-thing. It would be highly coöperative for a few working hours and highly individualistic the rest of the day. It would accept the notion that working together bee-fashion is the answer to

the question of maximum production in minimum time; but being a super-thing, it would reject the notion that the honey gathered should all get into the hands of a few crafty speculators to be sold back at the speculators' price. It would control distribution with the same bee-like coöperative efficiency that it used in production.

It would accept the axiom that self-expression is necessary to a thinking super-thing—that monkey play in a monkey way is after all the best fun in life. It would approve the bandar-log system, in which the individual in his idle hours may sit on a limb and philosophize, or try a new way of weaving twigs, or join the bunch in a frolic, or play with the kids.

Obviously, the bandar-bee would be a clear and direct thinker. He would be an intense individualist—so intense an individualist that in order to have the maximum number of hours a day for individualism, he would sink his individualism when he came to his production and distribution hours, and be an intense coöperator. He would treat as wasters those superbees who would work themselves and others without any thought of the monkey play, merely to amass a personal pile of honey. There would be piles of honey, adequate personal piles, but not huge ones.

Individualism and self-interest are about the same thing. The date when the bandar-bee will appear on the earth depends upon the amount of hammering which mankind must undergo, to pound into it a realization of the fact that in the long run self-interest can be most permanently promoted by intense and unselfish coöperation in production and distribution.

The Water-Power Bill

A SPECIAL committee of eighteen members of the House has devoted a week to hearings upon the Administration's Water Power Bill. This bill, which is a proposed House substitute for the Shields Bill as passed by the Senate, creates a commission consisting of the Secretaries of War, Interior and Agriculture and having an executive officer to be appointed by the President. This commission may grant licenses for the development of power projects upon navigable streams or streams located upon public lands for terms not to exceed fifty years, at the end of which time the Government may renew the license, transfer it or take the project over itself.

The tentative draft of the bill, commented upon in *Power* of February 19, provided that the Government on recapture should pay for the project "the fair value not to exceed actual cost of the property taken." Inasmuch as a large proportion of the original investment might have been retired through depreciation and amortization during the fifty years' tenure, it would be possible, as was pointed out in the editorial referred to, for the promoter, in addition to a fair profit during that time, to receive back much more than he put into the project. This has been taken care of in the draft of the bill now before the committee by providing that the Government shall have the right, on the termination of the license, to take over the project upon the payment of the "net investment" of the licensee. This net investment is defined as the actual legitimate cost as defined and interpreted in the "Classification of Investment in Road and Equipment of Steam Roads, issue of 1914, of the Interstate Commerce Commission" plus similar costs of additions thereto and betterments thereof minus the sum of the following items properly allocated thereto, if and to the extent that such items have been accumulated during the period of the license from earnings in excess of a fair return on such investment: (a) Unappropriated surplus, (b) aggregate credit balances of current depreciation accounts, and (c) aggregate appropriations of surplus or income held in amortization sinking fund or similar reserves or expended for extensions or betterments.

Dependence for the regulation of rates, service, issue of securities, etc., is placed upon the public-service commissions or other authorities of states where such regulation is provided. Where no such local regulation exists, the Federal commission has authority. A rental, not less than ten cents per horsepower per annum, is to be charged, except to states and municipalities. Whether this is based upon the potential, installed or developed capacity, or the amount of power sold is not clear. This, if kept to the minimum, represents not much more than an administrative charge, but is applied in part to the improvement of the lands and rivers upon which the project is located. There was no objection to the rental, as the operator will simply pass it on to the consumer. One of those who took part in the discussion suggested making the maximum fifty cents per horsepower annually so that it would not become a burden in meeting competition.

The presentation was arranged to show the benefits that would accrue from the development of the powers; then that the privileges that the Government is offering are not so valuable as is popularly supposed because water powers can compete with steam power only under favorable conditions, and that projects must not be burdened with too many restrictions and handicaps; then to seek the modification of the bill in those respects in which these handicaps might be supposed to lie. These were chiefly in the tenure and recapture provisions.

Our preference has been for a license revocable at any time on repayment of the net investment. There is an argument for the term license, however—not that which is usually advanced, that the project cannot be financed without a franchise valid over the lifetime of a long-term bond, for the recapture provisions of an indeterminate license could protect the investment however soon it was taken over, but that the chance of making a profit is the incentive for the promoter. If the Government can take it by restoring what has been put into it as soon as it begins to pay a profit, his chance for remuneration is jeopardized.

The bill provides that the commission may in its discretion give preference to applications for licenses by states and municipalities for developing power for state and municipal purposes. Municipal purposes are defined as "all purposes within municipal powers as defined by the constitution or laws of the state or by the charter of the municipality where any such purpose is directly pursued by the municipality itself with the primary object of promoting the security, health, good government or general convenience of its inhabitants," and licenses may be issued without charge for the development, transmission or distribution of power solely for state or municipal purposes.

As the Federal Government would be unlikely to recapture a project and operate it by selling the power, the opinion seemed to be that unless it acquired it for a governmental purpose, as for making nitrate, ammunition, etc., or operating Government-owned railways, projects would, on the expiration of the licenses, pass into the possession of the municipalities that they served unless satisfactory terms could be made for renewal. Municipality, as used in the bill, means a city, county, irrigation district or other political division of a state competent under the laws thereof to carry on the business of developing, transmitting or distributing power.

At the present rate of development it is difficult to predict what social and industrial conditions may be fifty or more years from now, but the bill appears to safeguard as well as possible the interests of the public while offering security to capital and incentive to enterprise.

America Calls to Americans

ON APRIL 6, one year from the day the United States entered the war, the Third Liberty Loan will be offered for subscription. It is imperative that it should be oversubscribed. It is frequently asserted that the moral effect of a magnificent response will be felt among our Allies and by the enemy. While this is undoubtedly true, there is another reason why the money should pour in, which must not be overlooked—*It is needed!*

Each day sees some new demand for extraordinary expenditure. The shipbuilding program alone will entail an outlay that must be stupendous. The building of aircraft calls for immense appropriations. And these are only two items in the cost of the war. The maintenance of troops at home and abroad and a hundred other expenses are mounting every day.

There can be no question that this Third Loan will be made at a time when the war has reached a critical stage. Money and more money must be expended. The Allies can no longer contribute in amounts that are necessary at this crucial time. America must furnish the sinews of war. And America calls to Americans. That is all that need be said. To think that she should appeal in vain is impossible.

The school children of New York City alone are preparing to raise $50,000,000. Surely, American men and women would be ashamed to look these children in the face if they failed to grasp the privilege which is offered of aiding America at this critical time in the history of the nation.

Conservation of Natural-Power Resources in Australia

THE article on hydro-electric power development in Australia and New Zealand, published on page 465 of this issue touches a question which is just now of great interest to the American reader. It appears that the Australians have decided to make as wide a use as possible of their natural-power resources in the future, and also that they are not willing that these resources shall be exploited by private capital, but shall be developed by the nation in the interest of the nation.

The realization of the great importance which hydro-electric development will play in the economic life of Australia and New Zealand so far has found expression in the carrying out of vast schemes of hydro-electric power generation. Of these, the great development contemplated in the North Island of New Zealand deserves special attention. When completed, this enterprise will not only tap most of the best power sources known at present, but will also be interconnected in such a way as to make the resources of each development available for all the other developments.

The whole of the work is carried out by the government, and the government will be the owner of the generating stations and the means of distribution. The cities and large consumers of electrical power will buy from the government. By this scheme a guarantee is offered that the resources of the country will be developed so as to give the best results.

Australia and New Zealand have been very far-sighted and fortunate in taking early steps to prevent the unhealthy exploitation of their natural-power resources. Laws passed years ago have made the undertaking of electrical enterprises dependent upon government license, and when the time came to tap the great dormant power resources of the country the government's position was strengthened by additional laws giving to the nation virtual control of all the existing resources.

Does Rhode Island Need a License Law?

DURING the last few weeks we have published accounts of an unusually large number of boiler explosions. On page 463 of this issue is a report of another one in which three persons were killed and four were seriously injured.

Nothing is definitely known as to the pressure carried at the time. One hour and forty minutes before the explosion the gage registered fifty-five pounds pressure and sufficient water was showing in the gage-glass. Two factors stand out prominently, one being that the safety valve was found frozen solid the day after the explosion, although the weather was not sufficiently cold to produce this result. The other is that the man who was operating the boiler was performing this duty without a license, and, furthermore, the State of Rhode Island does not make it necessary for a boiler attendant to have one.

Some good may result from this explosion in that it may lead to the adoption of a city, if not a state, law governing the supervision of steam plants and the licenses of those engaged in their operation.

Suggested Caution Warranted

In spite of the coal shortage this winter, the showing made in the annual statement of the Rhode Island Coal Co., just issued, is the worst on record, with a deficit of more than half a millions dollars. The December deficit alone was $102,347.76. And yet coal mining is generally a profitable business, and Rhode Island coal has lasting qualities.—*Boston Globe*, Feb. 27, 1918.

Before purchasing any of the 400,000 shares of stock offered in the pamphlet previously mentioned, investigators would do well to make a thorough investigation, visit the mine and form their own conclusions.—*Power, Oct. 5, 1909.*

Correspondence

Does a Bonus System for Firemen Pay?

Many articles have been written advocating bonus systems for firemen on a CO_2 or high-evaporation basis, but my experience is that competition among firemen has not always produced the desired results when the actual conditions are known, for, however dense and ignorant of the laws of combustion a fireman may be, it does not usually take long for him to learn how to beat a CO_2 recorder or to find means whereby he can juggle evaporation.

Almost every fireman, whether he is working under a bonus system or not, likes to receive credit for a good day's work, and there are always a few unscrupulous ones who will adopt underhand tricks in order to increase their own prestige. The percentage of these unscrupulous ones may be small, but they are usually present in sufficient number to defeat the object of any system or friendly competition ever devised or inaugurated.

In a small hand-fired installation where a CO_2 recorder is used, the fireman on each watch tries to make a good showing on the chart. One fireman in cleaning the fire under the boiler to which the recorder happens to be attached does a "half job"; merely pulling out the loose dirt and clinkers, leaving the heavy clinker formation on the bridge and side walls, cleaning the fire just sufficiently to enable him to "get by" for the remainder of his own watch. As a result of such a cleaning, the CO_2 on the chart is down for but a short time. When it is the next man's turn to clean that particular fire it is in an awful condition—the clinker formation on the walls is hard as cement and has covered a large part of the great area. This fireman is perhaps conscientious in the discharge of his duties, and by hard labor and loss of considerable time he manages to remove the clinker and regain the lost grate area. But the record he has made on the chart is anything but "pretty," the CO_2 has been down for a long interval.

The chances are that the unscrupulous fireman is credited with being a speedy and skillful man, while the conscientious fellow is criticized for his poor showing. The usual result is that the fireman so censured, rather than start a controversy, either seeks another position or else resorts to the other fireman's underhanded methods. The efficiency of the plant suffers in either case. When there is considerable difference in the results obtained by the different firemen, the engineer should ascertain the true reasons for such before bestowing praise or censure.

Some time ago I read an article about a certain plant where a competition was fostered between the boiler-room crews on the different shifts to see which crew could obtain the best evaporation. The results so obtained and published were misleading, the actual conditions were not made known—some of the tricks resorted to by the night crew to bolster up the evaporation on that shift. The coal passer who was responsible for the weighing of the coal, after having got well caught up on his work was in the habit of going to a quiet corner best known to himself, for a little nap. The fireman would seize this opportunity to sneak in an extra car or two of coal, which of course was never recorded. "Cracking" the blowoff and other means they had of getting rid of the water were resorted to. Whether any such methods were practiced by the crews on the other shifts or as to how long these practices went undetected, I do not know, but certainly the competition so fostered came far from attaining the desired results.

In my estimation intelligent and appreciative supervision, good working conditions, fair wages and reasonable hours will pay the plant owner greater dividends than all the bonus systems or competitions ever devised or inaugurated. By reasonable hours I do not mean seven days a week for, however interested an engineer or fireman may be in his work, he needs one day of rest and relaxation if he is to maintain his maximum efficiency. I am glad to note that there seems to be a growing tendency among the more reasonable employers to recognize this fact.

L. L. SPRAGUE.

Andover, Mass.

There Should Be an Ash Inspector

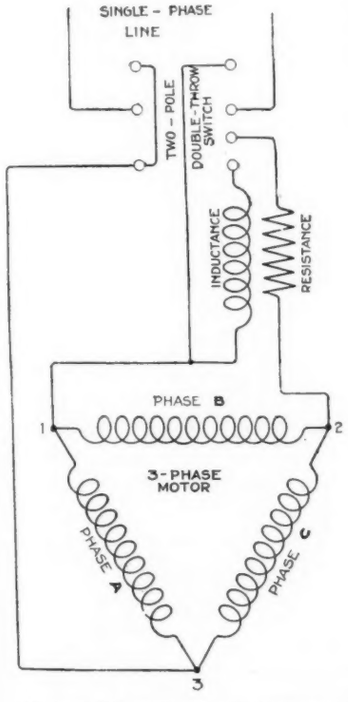
Reading the editorial, "Why Not Have an Ash Inspector?" in the issue of Feb. 19, page 267, reminds me of a suggestion that I made the local fuel administrator some time ago—to appoint a capable man clothed with authority to visit plants, commercial and domestic, and to say to the owners or operators: "Your fuel is not suited to the conditions," or "Your grates are not right," or "Your draft is not handled rightly," "Your settings are leaking," or any of the many things that go to prevent getting good results. He should show the operator how to handle the furnace, then see that instructions are followed or cut the fuel off, whether it be the fault of the installation or of the men handling it. In homes there are many heaters that are wasting a lot of fuel where an expert could help out, and the owners would be glad to save if they knew what steps to take to do so.

My suggestion to the fuel administrator was not acted on for the reason, as stated, that there was no provision for such a man nor funds with which to pay one. Why should a power plant, where the men and the company are trying in every way to save and run economically, be compelled to stop to save coal for those who are wantonly wasting it? It is not fair and is very discouraging to the ones that are trying and "working their heads" off to save. There certainly should be an ash inspector and one who knows something besides what he has learned from some textbook.

Binghamton, N. Y. ASA P. HYDE.

Operating Polyphase Motors Single-Phase

The letter in the issue of Jan. 29, by F. W. Plumb, on operating two-phase motors single-phase recalls two incidents in my experience along a similar line. A power company in a Southern city made it a practice to run long single-phase primary extensions out into the country in order to furnish lighting and single-phase power to the farmers. One such customer had ordered a corn shredder and a single-phase motor to drive it. The machine was delivered, but the motor was delayed in transit and it became necessary to get the machine running. No other single-phase motor of sufficient size was available, so it was decided to attempt the work with a large three-phase machine. The motor was installed and a phase-splitting device built, as shown in the figure, to assist in starting. After some adjustment of the phase-splitting coils and a little assistance on the belt, the motor came up to speed with the switch in the down position; then the switch was thrown up, which connected the motor directly to the single-phase current. The motor continued to operate in this manner until the single-phase machine was delivered and installed.



PHASE-SPLITTING CONNECTION

In another case a small central station had two generators, one single-phase and the other a three-phase. The single-phase machine was used only in emergencies and to furnish light when there was no power load on the plant. One of the manufacturing plants in the town used several small three-phase motors and one larger machine of the same type, which, however, was only partly loaded. The three-phase generator broke down and required several days for repairs to be made; in the meantime, the power consumers desired to continue operations.

A temporary single-phase connection was made to the large motor and a split-phase device constructed for the purpose of starting the large machine. After the large motor was started on the single-phase circuit, it was thrown over on the three-phase line, one phase of which was connected to the single-phase generator. In this way the three-phase motor was made to operate as a single-phase to three-phase converter in addition to pulling its own load on single-phase power, so that the small motors could be started and operated on three-phase power as formerly. The large motor now operated at nearly full load, but the small motors took about the same power from the circuit as when supplied from the three-phase generator.

D. R. SHEARER.

Johnson City, Tenn.

Single-Phase Operation Caused Low Power Factor

With frequency changers operating in parallel, both the motors and the generators must be in phase. With the motors locked in phase with the main generators and the motors having a different number of poles than the generators of the frequency changers, there is evidently only a certain relative position in which the generators of the sets will be in phase. If this position is not obtained when the motors are switched in, it becomes necessary to do what the operators term slipping poles on the motor. This is accomplished by opening the motor switch long enough for the synchronizing indicator on the motor to make a complete revolution, indicating that the rotor of the motor has dropped back one pair of poles, with regard to the main generator, and then closing the switch when the motor is again in synchronism.

This may have to be repeated a number of times on some occasions, to bring the generator of the frequency changer sets to be paralleled in phase with the one that is running. It is a job that requires careful handling even for an experienced operator, because the machine drops out of phase at an increasing speed when the switch is opened, and by the time it comes into phase again, the hand on the synchronoscope may be moving quite rapidly. If the change is not made properly, the whole starting operation must be done over again.

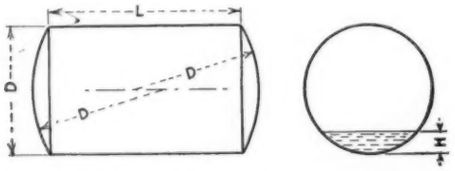
When two alternating-current generators are paralleled, the indicator of the synchronoscope always swings to the zero point and remains rigidly in this position. One morning, however, after cutting in the motor of a 2000-kw. frequency-changer set, the indicator made several swings back and forth across the zero point before it finally decided to stay there. Nothing else happened and the machine kept on running, so I went ahead and cut in the generator. As luck would have it, the generator happened to be in phase, and it was not necessary to slip poles on the motor to get the latter in phase. When the exciting current of the motor was adjusted so as to maintain unity power factors, it required something like twice normal value.

I had always made it a practice to go up on the switch gallery and examine the high-tension switches as soon as possible after each operation. This is what probably saved trouble this time, as there was only a small fraction of a load on the machine and no doubt, under the conditions afterward found, as soon as load came on the machine would have pulled out of step. When I came to examine the switch, the cause of the trouble was at once evident. One of the wooden rods which closed the switch, there being one on each phase, had been broken; consequently, the motor was operating single-phase. As a temporary measure I took a stick and pushed the broken section into place, thus closing the third phase of the circuit. This made it necessary to reduce the exciting current for the motor to its normal value, to maintain unity power factor.

Minneapolis, Minn. E. W. MILLER.

Calculating the Contents of Oil Tanks

There is a timely article in the Jan. 22 issue of *Power*, on the calculation of the contents of horizontal cylindrical tanks with dished heads, when the liquid is at different levels. The writer has no criticism whatever to offer concerning Mr. Strohm's method, which is the most logical way; but the time involved in getting up a table of capacities by that process is a nerve-trying ordeal—as the writer knows! It is evident that for the tank mentioned in Mr. Strohm's



DIMENSIONS USED IN FINDING CONTENTS OF TANK

article it would be necessary to use the circular-segment formula forty-eight times, to obtain the volume at every inch of depth of the liquid for one-half of the tank.

The writer is employed by a large byproduct coke company, and the average plant of this nature has many storage tanks which must be calibrated and for which gages must be provided, so that the contents may be read at any time. He calibrated our tanks for a long time by the method given by Mr. Strohm, using a planimeter to obtain the areas of the segments, thus decreasing the labor somewhat. But our troubles came to an end when the writer discovered, in an old paper on chemistry, the formula,

$$V = 7.48D^2Lf_1 + 14.96D^3f_2$$

in which

V = Contents of tank in U. S. gallons at the depth considered;
D = Diameter of tank in feet;
L = Length of tank in feet;
H = Depth of liquid in tank;
f_1, f_2 = Factors whose values depend on the value of H, as shown in the table.

The meanings of the several letters may be more readily understood from the accompanying illustration.

VALUES OF f_1 AND f_2 FOR DIFFERENT DEPTHS

H	f_1	f_2	H	f_1	f_2
0.05	0.014681	0.00017	0.30	0.198168	0.01048
0.10	0.040875	0.00085	0.35	0.244980	0.01386
0.15	0.073875	0.00221	0.40	0.293370	0.01805
0.20	0.111824	0.00420	0.45	0.342783	0.02234
0.25	0.153546	0.00687	0.50	0.392699	0.02697

It should be noticed that the table gives the values of the factors only for every 0.05 of the diameter of the tank, whereas it is usual to calibrate tanks for each inch of depth. This difficulty can be overcome by calculating the capacities at all depths from 0.05D to 0.50 D, and then plotting the results in the form of a curve on cross-section paper, to a sufficiently large scale. The vertical scale can be used to represent depths and the horizontal scale to represent capacities in gallons. After the curve is carefully plotted, the capacity at any inch of depth may be read from the horizontal scale. By this means the formula need be used only ten times, instead of once for each inch of depth.

Pittsburgh, Penn. WILLIAM C. STROTT.

[From the sketch shown by Mr. Strott, it appears that his formula is strictly applicable only in case the radius of the dished head is equal to the diameter of the tank, although it will probably give results accurate enough for all practical purposes when applied to any horizontal cylindrical tank with dished heads.—Editor.]

Sucking from a Condenser

In the issue of Jan. 29, 1918, there is another letter [Others on pages 807, Dec. 11, and 740, Nov. 27—Editor.] on "Sucking from a Condenser," and I have read all the previous articles, but the matter was brought home by the same thing happening in the plant of which I have charge, breaking both steam valves of a Corliss engine. The circumstances as reported to me were as follows: The engineer had just shut off the steam to stop the engine, and was going around to the other side of the cylinder to shut the valve in the exhaust line between the engine and air pump or jet condenser, when there was a sound of water in the cylinder and a discharge of water from the relief valves. On examination I found both steam valves in eight or ten pieces each and the floor wet from the water, although it must have been twenty minutes after the accident before I got to the engine room.

The question is, Where did the water come from if not from the condenser? My conclusion, after studying the matter, is this: When this plant was built, the exhaust from the engine was dropped about 2 ft., then carried horizontally for about 15 ft.; there is a tee and two 45-deg. bends in this length; the condenser is connected to the tee, then it turns up with an elbow to the relief valve to the atmosphere. Now this pipe past the tee makes a dead end in which a certain amount of water is held by the exhaust from the engine; and when the steam was shut off, a few strokes of the pump cleared the engine of steam pressure, so that there was a partial vacuum as far back as the throttle valve, as

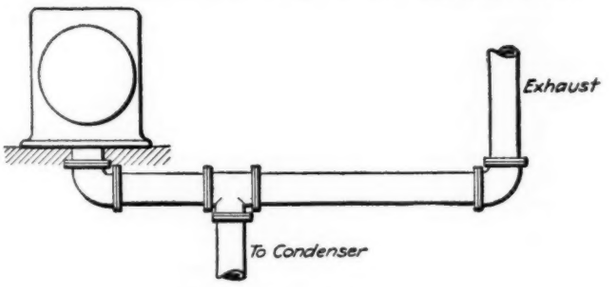


DIAGRAM OF EXHAUST PIPING

the action of the piston would raise the exhaust valves off their seats and give the water in the dead end a surge or wave toward the engine—in fact, enough to carry it past the tee and into the engine so that the action of the piston would be as much of a vacuum pump as the pump itself.

This is the second condenser that I have found connected in this way (off a tee). In the other case the condenser was condemned as "no good" until I changed it from the tee to the end of the pipe and put the relief valve on the tee; since then it has been working satisfactorily. The same change is required in this latter case, but the engine is used only in case of emergency and it is difficult to make the change, so it has not been done yet. J. DRUMMOND.

Granby, Que., Canada.

Telescopic-Oiler Discussion*

The discussion of telescopic oilers recently appearing in *Power* has brought out useful points. As H. Hamkens pointed out at the beginning of the discussion, the main disadvantages of most telescopics, especially the older ones, are too many parts, leakage of oil, tendency to irregular feeding and too rapid wear.

It is true that the older telescopics were somewhat complicated and that, with numerous springs, locknuts, washers, etc., they were hard to keep in repair and in good working order. But the design has gradually been simplified and improved until today oilers can be procured which are apparently as simple as it is possible to make them.

As Mr. Fenno pointed out in his article in the July 17, 1917, issue, the tendency to pumping and irregular feeding can be overcome simply by providing suitable clearance between the inner and outer telescopic tubes.

The rapid wear of the tubes noticed by Mr. Hamkens in some instances, is the result of their binding upon each other due to imperfect alignment either when installed or after reassembling. This can be avoided by due care when installing and, with some telescopics, extreme care when reassembling. It all depends upon the type of joint employed.

By employing the special design of true male and female joint shown in the illustration, all wear due to imperfect alignment, except that due to poor installation, is completely avoided, because no threading is even disturbed. Also, because this joint permits of gravity feed, the pumping tendency is practically, and leakage completely, eliminated.

With the arrangement shown by Mr. Fenno and illustrated in Fig. 1, the oil accumulated at the bottom of the outer element as at *A*. In other words, the flow of oil is against the direction of the joint instead of with it. Hence, the fiber packing *B* is always in contact with the oil and subject to deterioration and leakage.

In most of the older designs the joint could not be taken apart without first unscrewing the telescopic pipe. This meant that with any irregular alignment whatsoever in the initial assembling, the pipe would have to be screwed up to exactly its original position when reassembled, or extreme wear was sure to ensue.

With the type of joint shown in Fig. 2, both wear and leakage are practically overcome. The overhanging lip *D* drops the oil from the movable element *E* directly into the hollow of the fixed element *F*, and hence, unless the oil is fed in a flood greater than the latter can conduct it to the pin, the joint *G* remains leakless.

The joint is taken apart by sliding off the spring clip *H*, which is attached to the loose collar *I*. The movable element *E* then slides out of the fixed element *F*. As the construction at the top of the telescopic is similar, the telescoping pipes may both be removed without detaching them from their parts of the joints. Hence, they can always be replaced in alignment. As no nuts or screws are used in putting the joints together, they may be taken apart for cleaning or inspection while the engine is running unless the speed is uncomfortably high.

WILLIAM W. NUGENT.

Chicago, Ill.

*See "Power" 1917, Jan. 30, p. 142; Mar. 6, p. 325; Apr. 3, p. 463; May 22, p. 707; May 29, p. 748; July 17, p. 96; Sept. 18, p. 399; Dec. 11, p. 806.

Lime As a Protection for Steel

In the issue of Feb. 26, on page 301, there is an interesting letter by N. Bowland, on "Why Hot Water Pipes Pit," which gives as the reason for the rusting of steel and iron the unlike polarity of different parts of the material, setting up galvanic currents. To have a galvanic current requires, as is well known, an electrolyte, usually an acid, however weak, such as comes from vegetation sometimes and through the pollution of streams by sewage and the liquids from factories of different sorts.

In this connection I was led to the belief that if the solution was made alkaline there would be no electrolysis. To test this out, two pieces of commercial angle iron were cut from the same bar and placed in separate jars filled with river water, but to the water in one jar a handful of spent lime was added, while that in the other jar was left natural. Before immersing the two specimens in the water thus prepared, they were sandblasted to remove all mill scale and rust except one face that was left as it came from the mill and one face of each specimen, in addition to sandblasting, was polished to a fine surface. Both specimens were immersed in the jars on the same date, Oct. 2, 1915. The one in the natural river water began to rust immediately and is now covered with a thick coating, and much oxide has fallen off and covers the bottom of the jar. The other remains exactly as when put in. The polish on this specimen, immersed in lime water, is as perfect as on the day it went into the jar. The sandblasted side shows no rust whatever, but on the natural side there is one small speck about ⅛ in. in diameter which is brown in appearance, but there seems to be no appreciable increase in area or thickness of this brown spot from month to month.

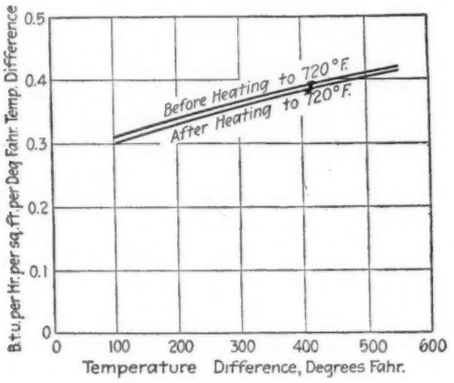
This protective action of lime water is made use of by English hostlers, who are accustomed to take the highly polished steel bits from the horses' bridles when they come in from a trip and throw them into a bucket of lime water to prevent them rusting before they get time to give them their daily polishing. I find that lime water is effective in preventing rust in the bottoms of steel hulls, which nearly always have more or less bilge water in them, often from condensation of atmospheric moisture when there is no leakage. Whitewash is also an excellent preservative of steel in inclosed places like the air tanks in steel gates, where it effectually banishes rust and at a fraction of the cost of paint. It needs occasional touching up where condensation water drips from the top of the tank. It is a cheap remedy where applicable, but of course it will not stand abrasion or where the steel is under running water. It has been used for coating the tanks of the 50-ft. gates of the Mississippi River lock with the best of results. It seems to show that where the acid of the water is killed with lime, no electrolysis can take place.

The experiment is easy to make, but it seems not generally known what a good and cheap preventive of rust lime is when mixed with water. Readers of *Power* may find many uses for this simple protective and possibly someone may find a way to combine lime with a paint that will stick to the metal under water, making an ideal coating for steel.

Keokuk, Iowa. MONTGOMERY MEIGS.

A Correction Regarding the Use of 85 Per Cent. Magnesia

In the May 1, 1917, issue of *Power* there appeared, on pages 593-6, a reprint of a report made by the Mellon Institute on heat-insulating materials. In both this report and in the editorial commenting thereon (page 604 of the same issue) statements regarding magnesia were made, which should be clarified and corrected, particularly as, in view of the present urgent



CONDUCTIVITY OF MAGNESIA HEATED TO 720 DEG.

necessity for conserving our coal supply, the true value of steam-pipe and boiler coverings for saving coal should be recognized and the proper use of such coverings encouraged. The editorial was partly rectified in the July 17, 1917, issue (page 90), but in view of the fact that reprints of the original article and editorial are being freely circulated, we desire to emphasize the true meaning of the original report.

It was stated in the original that "even when subjected to low temperatures, it is only a matter of time before disintegration (of magnesia) takes place, as is well known from the behavior of magnesia coverings for steam pipes." And in the editorial this assertion was regarded as proved by the report, since the comment made was: "It is brought out that when subjected to low temperatures it is only a matter of time before disintegration of this material (magnesia) takes place."

The tests reported upon in the article cited were made for the purpose of determining the relative values of various refractory materials for furnace insulation, involving a set of conditions totally different from those for which magnesia is intended for use, conditions for which magnesia is admittedly unfitted. The high temperatures necessary in furnace practice are far in excess of those demanded by the highest steam pressures, even with a considerable degree of superheat in addition. It is well known that at a high temperature carbonate of magnesia loses combined-water and carbon dioxide, but this takes place at temperatures above 700 deg. F.

On page 594, in the article referred to, the statement was made: "It is well known that magnesia is equal in insulating value to many times its thickness in ordinary firebrick, so long as disintegration does not take place." We should like to restate this as follows: "It is well known that magnesia is equal in insulating value to many times its thickness in ordinary firebrick, when applied to temperatures suited to its use."

Magnesia is not a refractory; and the statement that disintegration of magnesia takes place at *low temperatures* refers to the temperatures of *furnace linings*, where 700 deg. F. might reasonably be called a low temperature. Such a temperature is much higher than magnesia, as a heat-insulating material, encounters in its regular day-in and day-out service. Even this temperature, however, can safely be used in steam pipes covered with 85 per cent. magnesia. In the accompanying diagram the upper curve shows the conductivity of a 2-in. thick magnesia covering before being subjected to a temperature of 720 deg. F. The lower curve was taken just after this test and shows that no damage was done to the covering but, on the contrary, that the thermal efficiency was slightly improved by the high temperature to which it had been subjected.

E. R. WEIDLEIN,
Acting Director,
Mellon Institute of Industrial Research, University of Pittsburgh,
Pittsburgh, Penn.

Repairing Worn Valve Stems

I have had experience with worn valve stems on Corliss engines as referred to by Mr. Oakley in the issue of Feb. 12, page 230, and find that it is best to build them up by the oxyacetylene process and turn them to the original size in a lathe, making a mechanical job of it.

Sleeves may be all right when one knows just what the conditions are, but the next man that takes charge does not know what has been done. So, if the bracket is cut away, it means that if he orders new ones from the manufacturer they will not be of much use without a ring in the bottom of the stuffing-box to keep the packing in place; and it will also be necessary to have special packing for the stems with sleeves on, whereas one size should fit all four stems. J. B. FREEMAN.

La Grande, Ore.

Measuring High Pressures with Dead Weight

In my article, "Measuring High Pressures with Dead Weight," appearing in *Power*, Feb. 26 issue, at the bottom of Table II, on page 288, is a note which reads: "Fifteen pounds per sq. in. equals 30.35 in. of mercury; 1 in. of mercury equals 13.6 in. of water." This note should read: "Fifteen pounds per sq.in. equals 30.53 in. of mercury at 32 deg. F.; 1 in. of mercury equals 13.6 in. of water." SANFORD A. MOSS.

Lynn, Mass.

A Liberty Bond will soon become a badge of loyalty.

A Liberty Bond is a profit-sharing certificate on the prosperity of America.

A Liberty Bond is an old-age insurance policy, fully paid and nonassessable.

A Liberty Bond gives you a look into the future, but defeat in the war will tie you to an unfortunate past.

A Liberty Bond will pay you interest on the future of America. Defeat will make you pay compound interest on the future of Germany.

Inquiries of General Interest

Hotter Feed Water at Expense of Heating Capacity—We have use for all the exhaust steam from an engine that develops about 50 hp., but the exhaust-steam feed-water will not raise the temperature of the feed water higher than 200 deg. F. Would it pay to increase the size of the heater? K. R. R.

Where there is use for all the exhaust steam that is available, an increase of feed-water temperature would be of no benefit, for to accomplish the same heating by the exhaust as at present, the heat going to increase the feed-water temperature would need to be made up by live steam or some other source of heat.

Two Induction Motors on the Same Load—Is it practical to connect two induction motors on the same lineshaft where the load is varying? One motor is 300-hp. and the other 100-hp. capacity. G. C. T.

It would not be advisable to attempt to operate two motors of any type on the same load. If the machines are the same size and constructed to have the same characteristics, they probably would operate fairly satisfactorily. But when they are of different sizes or types, the probabilities are that one motor will take over more than its share of the load. This is readily understood when it is considered that one machine may take its full load at 5 per cent. and another at 10 per cent. decrease of speed.

Heating Surface and Grate Area for Steam-Heating Boiler—What number of square feet of heating surface and grate area should a boiler have for a low pressure steam heating apparatus to supply 1500 sq.ft. of direct radiating surface? W. B. C.

In estimating the required size of boiler, the number of square feet of direct radiating surface must be understood to include the surface of uncovered piping. Using good anthracite, or the better grades of bituminous coal, and with a good draft and usual frequency of firing, the boiler-heating surface should be equal to the total number of square feet of radiating surface divided by about 7.5 and the grate area should be equal to the total radiating surface divided by about 160. Hence for 1500 sq.ft. of radiation and pipe surface, the boiler should have about 200 sq.ft. of heating surface and 9⅜ sq.ft. of grate area.

Testing Out Correctness of Indicator Reducing Motion—How may it be determined whether an indicator-reducing motion is correct? E. T.

For determining the truthfulness of a reducing motion as used with a given indicator on a given engine, place the engine on a center, make a mark on the crosshead corresponding with one made on one of the guides and then turn the engine over to the other center and make another mark on the guide to correspond with the mark on the crosshead previously referred to. The distance between the marks made on the guide will be the length of stroke. Subdivide this distance corresponding to eighths of the stroke and, for greater accuracy, lay off sixteenths at the ends of the stroke, having all divisions so located that they may be matched with the mark on the crosshead for properly placing the crosshead and piston at the different positions they would occupy for the selected fractional parts of the stroke. With a spring in the indicator and a blank card on the paper drum, trace a long atmospheric line by drawing out the cord by hand. Then hitch the cord to the reducing motion and with the engine placed so the crosshead mark registers with one mark after another on the guide, raise the pencil arm of the indicator a short distance above the atmospheric line and obtain a trace for each position of the crosshead. If the reducing motion is correct, the distances between the tracings of the pencil will be in proportion to the corresponding fractions of stroke laid off on the guide.

Allowable Boiler Pressure for Stay-Bolted Water Leg—What would be the safe working pressure for the water legs of a locomotive type of boiler having plates ⅜ in. thick, with screwed and riveted stay-bolts ⅞ in. outside diameter, pitched 6 in. centers? F. R. B.

According to the A.S.M.E. Boiler Code, the maximum allowable working pressure for stayed flat plates should be calculated by the formula

$$P = C \times \frac{t^2}{p^2}$$

in which

P = Maximum allowable working pressure, pounds per square inch;
t = Thickness of plate in sixteenths of an inch;
p = Maximum pitch of stay-bolts;
C = 112, for stays screwed through plates not over ⅞ in. thick.

By substituting,

$$P = 112 \times \frac{6 \times 6}{6 \times 6} = 112 \text{ lb. per sq.in.}$$

Screwed stay-bolts ⅞ in. diameter, 12 threads per inch, would be 0.7307 sq.in. diameter at the bottom of the screw thread and have a net cross-sectional area of 0.419 sq.in. With an allowable load of 7500 lb. per sq.in., each stay-bolt would be capable of sustaining a load of $0.419 \times 7500 = 3142.5$ lb. The plate area occupied by each stay would be $(⅞)^2 \times 0.7854 = 0.6013$ sq.in. and the net plate area supported per stay would be $(6 \times 6) - 0.6013 = 35.3987$ sq.in. Hence the safe working pressure would be limited to the allowable working pressure for the stay-bolts, namely, $3142.5 \div 35.3987 = 88.7$ lb. per square inch.

Temperature of Steam After Passing Through Reducing Valve—If steam at 90 lb. gage pressure and 97 per cent. dry is passed through a reducing valve and the pressure is reduced to 5 lb. gage, what will be the temperature and quality? C. A. C.

According to the steam tables, the heat of a pound of dry saturated steam at a pressure of 90 lb. gage, or 105 absolute, consists of 302 B.t.u. in the water and 885.2 B.t.u. latent heat, so that if 97 per cent. dry, each pound of the initial steam contained $302 + (885.2 \times 0.97) = 1160.6$ B.t.u. In passing through the reducing valve, some heat is lost by radiation from the surface of the valve to the surrounding medium, depending on the character of insulation, but as loss of heat from friction is small, as the temperature within the valve is rather less than the temperature of the initial steam, loss of heat from radiation may be neglected; and as any work done on the steam in moving itself through the valve is restored when the steam is brought to rest, it may be considered that each pound of the steam after passing through the reducing valve, although reduced to the pressure of 5 lb. gage, contains as much heat as it contained in the initial condition, namely, 1160.6 B.t.u. Reference to the steam tables shows that a pound of dry saturated steam at 5 lb. gage, or 20 lb. absolute, contains 1156.2 B.t.u., hence each pound would contain $1160.6 - 1156.2 = 4.4$ B.t.u. in excess of the heat required for a dry saturated condition. Allowing the specific heat of superheated steam at the reduced pressure to be 0.48, the steam would be superheated $4.4 \div 0.48 = 9$ deg. F. As the temperature of dry saturated steam at 5 lb. gage is 228 deg. F., the actual temperature would be $228 + 9 = 237$ deg. Fahrenheit.

[Correspondents sending us inquiries should sign their communications with full names and post office addresses. This is necessary to guarantee the good faith of the communications and for the inquiries to receive attention.—EDITOR.]

The Water-Power Bill

THE Administration's bill for the development and control of the water powers was referred to a special committee of 18, consisting of Titus W. Sims, Tennessee, chairman; Scott Ferris, Oklahoma; Asbury F. Lever, South Carolina; Frank E. Doremus, Michigan; Edward T. Taylor, Colorado; Gordon Lee, Georgia; Dan V. Stephens, Nebraska; John E. Raker, California; Ezekiel S. Candler, Mississippi; Carl Hayden, Arizona; John J. Esch, Wisconsin; Irvine L. Lenroot, Wisconsin; Gilbert N. Haugen, Iowa; Edward L. Hamilton, Michigan; William L. LaFollette, Washington; James C. McLaughlin, Michigan; Richard Wayne Parker, New Jersey; Sydney Anderson, Minnesota.

The week commencing Mar. 17 was set apart for hearings upon the measure. The bill, which has been considered in recent issues of *Power*, creates a commission consisting of the Secretaries of War, Interior and Agriculture and provides for the issue of licenses to those who wish to undertake the development of water powers upon navigable rivers or public lands for terms not to exceed fifty years. Rates and service will be regulated by the commission where there is no state regulation. The provision that the Government could take the property at the expiration of the license upon the payment of a "fair value not to exceed the original investment," which *Power* criticized in the original draft of the bill, has been changed so that the Government shall pay the "net investment of the licensee" as defined and interpreted in the Classification of Investment in Road and Equipment of Steam Roads, issue of 1914 of the Interstate Commerce Commission, plus similar costs of additions thereto and betterments thereof, minus the unappropriated surplus aggregate credit balances of current depreciation accounts, aggregate appropriations of surplus or income held in amortization, sinking fund or similar reserves or expended for extensions or betterments.

Mr. Merrill's Statement

On Monday O. C. Merrill, of the Forestry Division, one of the authors of the bill, presented a statement on behalf of its projectors. He showed that although there was a very considerable drop in the prices of material after the fixing of prices by the Government in 1917, prices still remained at the close of the year far above the pre-war level. Hydraulic machinery has advanced from 100 to 150 per cent. over 1914 prices; electrical apparatus, from 125 to 150 per cent.; steam-turbine generators, 150 per cent., and water-tube boilers, 170 per cent., with uncertain deliveries. The union scale of wages in classes of work found in power-plant construction has advanced in many cases from 25 to 40 per cent. since 1913. Operating costs have increased, owing to the higher prices of labor, maintenance, materials and fuel. Increased fuel costs have made the development of power by water increasingly desirable.

The demand for power has increased at an accelerated rate, until during the last two years the annual increment in power generated by commercial central stations alone has been from three to four billion kilowatt-hours, requiring an annual increase in installation of from one and one-half to two million horsepower. In the United States the kilowatt-hour output by central electric stations was 61 per cent. greater in 1917 than in 1914. During the four years from 1913 to 1917 the ratio of the operating expenses to gross revenue had increased from 62 to more than 68 per cent. The greater costs of construction and operation in connection with other demands upon capital make financing difficult. These conditions make water-power legislation that will offer capital a fair return and a certainty of tenure desirable.

Although new developments and extensions will be necessary to meet the demands of the immediate future, a considerable increase in the output of electrical energy could be secured by the combination of existing isolated plants into a single system through the medium of high-tension transmission lines. In 1912 the capacity load factor averaged only 26 per cent. for the United States and probably is not above 30 per cent. today. Eighty per cent. of the electric power development of Montana is in one system, and it has a capacity load factor of 58 per cent. Studies made in 1912 for New York City and Chicago showed that the consolidation of the operating stations in the latter city would have saved from $10,000,000 to $12,000,000 in investment. In New York it would have saved from $18,000,000 to $20,000,000 and would have reduced operating expenses by $1,000,000 a year.

Extent of Water-Power Resources Unknown

Nobody knows whether our water-power resources are 30 million or 300 million horsepower, or what is the relation of the powers to any particular market. An intensive study should be made of the conditions and possibilities. The bill coördinates the activities of the three departments that have to do with water power. Our industrial efficiency both during the war and thereafter will be increased or diminished according to whether we do or do not make adequate provision for the development of our water-power resources. Water-power legislation should be considered a war emergency measure and as such should be taken up by Congress and passed at an early date.

Following the presentation of his formal statement Mr. Merrill was questioned by members of the committee, remaining upon the stand all day Monday and Tuesday forenoon. He was interrogated principally on the following phases of the bill: Licenses, rentals, rates and rate regulation, and recapture of project. His replies brought out the following points:

The terms of the license should be absolutely definite and unchangeable for the entire period of issue. This is quite necessary in order to prevent any uncertainty in the mind of the licensee as to the conditions under which he can operate. It would be inadvisable to introduce any factor that would make the terms of the license subject to change. One member of the committee suggested that the term of the license should be for an original period of 50 years "unless the applicant should request and the commission agree upon a shorter term."

It was suggested that the application by the licensee for a new license should antedate the expiration of his original license by a definite stated period of time, which should be long enough to permit the delivery of a new license on the expiration of the old one. There was considerable discussion on the tenure of the license, but it was Mr. Merrill's opinion that the original term should be for 50 years and that any unusual conditions should be met by an adjustment in the rental charge.

Rental Charges Not for Revenue Purposes

Mr. Merrill felt that the rental charge should apply to the total capacity of the project and not to production only. While the rental would not have much to do with encouraging or discouraging the development of a project, yet any effect which it might have should be in the direction of securing maximum development. The idea of the rental charge is not to secure revenue for the Government, but it is made in return for the issuance of a license. The money thus received is to be used (1) to defray the cost of administration and (2) the possible necessity of recovering excess earnings which it is impossible to reach in any other way.

While the rentals should be nominal, they should be greater in those cases where the Government contributes land or some other tangible property to a project, and less where the Government has nothing to offer but the license. Whatever provision is made should be clearly stated in the license before it is accepted by the licensee. It was Mr. Merrill's opinion that it would be a better fiscal policy to charge a rental that would be nominal and that would not reduce earnings below a fair return or increase rates to the consumer. As between getting revenue for the Government and reducing rates to the consumer, rental charges should operate in favor of the latter.

Rate regulation on interstate business should be left to the several state authorities and handled locally as long as local authorities show the ability to act and as long as there is no disagreement between states. Federal jurisdiction should come in when other authority is insufficient.

The recapture clause is considered to be the most important in the bill, and it was Mr. Merrill's opinion that the basis for recapture should be an actual legitimate original cost of the property plus additions, less any funds accumulated in unappropriated surplus, depreciation and amortization. The price should allow nothing, however, for any unearned increment in value of the property, good will, going value or expected profit.

Judge Raker, of California, was solicitous regarding the effects of the measure upon the use of water for irrigation purposes.

Chairman Sims said that the Government was concerned with projects upon navigable rivers simply as means for improving navigation. A 10-ft. dam might effect this purpose, but a licensee might put up a 50-ft. dam in order to get the power byproduct. In case the Government recaptured such a project, could it operate it as a power plant and enjoy the returns from the greater investment? In other words, can the Government, under the Constitution, go into the power business? Mr. Merrill could not say. We do not know what the powers of the Federal Government may be fifty years from now.

Henry J. Pierce, of Seattle, told of a $25,000,000 project in which he was interested at the Priest Rapids on the Columbia River. It would make the river navigable from its mouth to 200 miles above the rapids, nearly to the Canadian border, develop 250,000 horsepower at the lowest flow of the river and as much again or more during the season of high water. This season of surplus power synchronized with the irrigation demand, and the extra power could be used to pump water to arid lands above the watered level. He thought that in the granting of licenses preference should be given to those who were already in the business and best qualified to carry out the development.

Calvert Townley, assistant to the president of the Westinghouse Electric and Manufacturing Co., although anxious in the interest of his company, which furnishes machinery for hydro-electric installations, to see the water powers developed, was a bear on the value of such projects, claiming that there were few water projects that offered much of an advantage over steam-operated plants. For this reason the Government should not encumber the privilege with onerous restrictions.

Public Interest Should Be Protected

E. K. Hall, vice president of the Electric Bond and Share Co., spoke for the investor. The interest of the public, he said, is to get the water powers into use. The first thing in any bill is to protect the public interest. Rates and service should be regulated through state or some Federal commission so that it will be certain that no unreasonable profit shall be made. But in order to interest capital the interest of the investor must also be protected. A hydro-electric development calls for a tremendous investment, with a very short tenure of the title and a very slow turnover. The money to build the public utilities of the country comes from small investors. From the point of view of the investor there are two fundamental defects in the bill. The contract has been made definite, and the investor knows what he is getting and what is expected of him. He is assured of the enjoyment of the privilege for fifty years and of the return of his capital at the end of that period if the Government at that time wishes to recapture the project. But if the Government does not want to take the property, he must continue to run it under an indeterminate and uncertain tenure. He cannot issue refunding bonds, because he does not know how long he may be allowed to hold the property. For this reason Mr. Hall urged that if the Government did not wish to take or transfer the property on the expiration of the license the license should be reissued to the holder for a term of thirty years.

The other defect was the provision that the Government could acquire the property at the expiration of the license on payment of the net investment. This assured the investor the return of what he had put into the project and had not already taken out besides his fair profit, but did not allow him to profit by the enhanced value of the property. In all other businesses the investor was allowed, besides what fair current profit he could make, to benefit by an increase in the value of the property while in his hands. In response to an inquiry by a member of the committee, he said that he considered this the best bill offered to date.

On Wednesday morning John A. Britton, vice president and general manager of the Pacific Gas and Electric Co., told of two projects in which his company is interested—one at Lake Spaulding and one on the Pitt River—which would be affected by the pending legislation. The company owned or controlled practically all the land, but in one case the pipe line would have to pass for a short distance through a portion of the forest reserve, and in the other case about 36 acres of Government land would be subjected to occasional flooding. It did not appear just, on account of these minor concessions, that the whole great project of which they were such an inconsiderable part should be brought under the provisions of the act, and he suggested amendments whereby such minor concessions might be granted upon a lease basis. He also suggested limiting the rental to not more than 50 cents per annum per horsepower generated. The bill provides that the president may take the plant for war purposes, and upon restoring it shall pay such just and fair compensation for its use as may be fixed by the commission upon the basis of a reasonable profit in time of peace. Mr. Britton pointed out that such a settlement would not recompense the company for the loss of customers driven over to competitors or for the investment in other plant necessary to hold them, and urged that this be made to read, "shall pay to the party or parties entitled thereto just and fair compensation for the use of the property."

Indeterminate Franchise with Investment Return

In response to an inquiry of a member of the committee as to how he would regard an indeterminate franchise with a guarantee of the return of the investment in case of recapture, he answered that that was just what they wanted. With these amendments the bill is the most workable bill that he has ever seen. Asked by Representative Taylor if he knew of any water-power trust interlocking directorates or combination of interests, Mr. Britton said that he could speak only for California, but there was nothing of the kind evident there. Even if there were, with the present method of rate control and regulation it could not be made onerous upon the consumer. Every public utility ought to be a regulated monopoly.

Chairman Sims asked what would happen if at the expiration of the license there were no other applicant, and the Government must either take the plant over, involving a large appropriation, or allow the licensee to continue, the licensee would not be in a position to dictate terms to the Government. Mr. Britton's reply was that with the present tendency of public thought, at the end of fifty years it would be no shock to the public if the Government took over and operated the plant itself. To Mr. Sims' urging that the money would have to be appropriated, Mr. Britton replied that it would be paid for a going concern and immediately begin to return a revenue under which conditions public and congressional approval of the appropriation would not be difficult to obtain.

The chairman thought that it would be impossible to obtain the appropriation of such large sums and that therefore the license would be in effect perpetual. Mr. Britton thought that the Government would be glad to recapture the project and turn it over to the municipality that would have grown up around it. The most that the original grantee can make is a reasonable return. If he makes a paying concern out of it, the Government can take it when the license expires. If he does not make good, the Government can leave him in his misery.

Asked whether this bill or the Shields bill, both unamended, was the better, Mr. Britton replied that in his opinion the bill under discussion by the committee would be the most attractive to capital.

H. T. Freeman, of Hartford, of the Connecticut River Co., said that his company in the first half of the last century had put a dam in the Connecticut River by the consent of the state legislature, before the Federal Government had begun to exercise control in such matters, and urged that the provision under which the commission might grant licenses to parties operating projects upon public lands or navigable rivers "under authority heretofore lawfully granted" might be so modified as to include such a case. He also argued for "just compensation" instead of return of net investment as the condition of recapture. The bill excludes as an element in determining cost, expenditures from funds obtained through donations by state, municipalities, individuals or others. Mr. Freeman said that in some cases customers paid for extensions of lines necessary to furnish them power, and it was explained that if the company eventually reimbursed the customer and acquired the line it became a proper element of cost, but if it involved no expenditure by the company it could not be so included.

The first excess-profit act ever passed in New England gave his company the right to make 8½ per cent. on its investment, after which the Government took 8 per cent. and any excess was divided equally between the company and the Government.

To Mr. Taylor's inquiry as to whether there was any water-power trust in New England, Mr. Freeman replied that on the contrary there is the fiercest kind of competition.

John J. Harris, of Hardin, Mont., president of the Big Horn Canyon Irrigation and Power Co., described the project in which he was interested and claimed that the Government would receive a benefit from it in flood control equivalent to what it received in improved navigation on navigable rivers and that this benefit ought to be considered in fixing the rental charge. Three years is not enough time to do the preliminary work. He was still presenting his case when the committee took a recess until Thursday morning.

Thursday Morning's Session

On Thursday morning Charles N. Chadwick, chairman of the Committee on Conservation of State Waters, Lands and Forests of the Chamber of Commerce of the State of New York, appeared in behalf of House Bill No. 9681. This bill seeks to create a national board of water conservation consisting of seven members appointed by the President by and with the advice and consent of the Senate, not more than four to be members of the same political party, each to be a citizen of the United States, and none to hold any other Federal, state or municipal office. They are to be appointed for seven-year terms so that the term of one commissioner will expire each year, and are removable only for incompetency or misconduct.

This board would have the control and the jurisdiction of the interstate waters of the United States. It would ascertain what are the interstate streams of the United States most available, desirable and best for development, control and jurisdiction, and study the problems relating to the conservation of the rainfall, the control of freshets, recovering desert and waste lands by irrigation and swamp lands by draining, and the pollution of interstate rivers; the utilization of the rainfall for potable purposes and for navigation and water transportation aided by storage reservoirs, regulation of stream flow and waterways, and for the development of hydro-electric and other power, and the control thereof. It would study the climatic conditions of the state and compile information and make recommendations concerning the revision and codification of the water laws and the passage of new laws coördinating Federal and state jurisdiction. It would make surveys, maps, plans, specifications, estimates and investigations with regard to interstate streams, and report to Congress with recommendations as to what action should in its opinion be taken with reference thereto.

Mr. Chadwick explained that interest has been centered upon the one problem of hydro-electric development, while the bill in favor of which he appeared dealt with the conservation and utilization of the rainfall for all purposes. The broad policy of the nation with regard to the disposition and use of its rainfall for various and conflicting purposes could not be determined by busy and transient cabinet officers but required the concentrated and continuous attention of specialists. The single executive provided for by the Administration Bill could not, single-handed, deal with the determination of the national policy in all phases of the question, and cabinet officers would become but rubber stamps for his recommendations. He doubted the constitutionality of that provision of the Administration Bill which conferred the right of eminent domain upon the licensee. Under it a licensee might condemn even municipal or state property, and the taking of private property for private use cannot be justified by a declaration of beneficent purpose. Under the Administration Bill there is likely to be a conflict of authority between state and Federal Government. There is also the question of riparian rights vs. rights of appropriation for beneficial purposes. In the East, with its congested population, the large question is the use of the water for potable purposes; in the West, with its large arid sections, that for irrigation. The commission should be composed of big men who will put in all their time, and the bill should be so drawn that they can deal with the whole, broad, general question.

Mr. Anderson, of the committee, pointed out that under such a bill each project would require an act of Congress.

Judge Raker, of California, evinced a live interest in the irrigation phase of the question and asked if the witness considered hydro-electric power as secondary to the other uses. Mr. Chadwick replied that the use for potable purposes should come first; next commercial uses, then navigation, and then hydro-electric.

Chadwick Bill Same In Substance As Administration Bill

Mr. Chadwick admitted that in substance his bill was the same as the Administration Bill, with the exception of the personnel of the commission. But, under his bill, the commission would not be subject to the will of one man who could reverse the policy of the country with regard to the administration and utilization of the rainfall.

C. F. Kelley, counsel for the Montana Power Co., said that the bill, though a compromise, appeared to afford a workable measure. He said that the bonds should be amortized within the duration of the original license, and stood out for "just compensation," instead of a return of the "net investment," as the condition of recapture. He agreed that unappropriated surplus accumulated from earnings in excess of a fair return on the investment should be deducted in computing the net investment, but claimed that such portion of such funds as had been reinvested in improvements and betterments should not be so excluded. He claimed that inasmuch as the prospective applicant would be at great expense in making surveys, maps, plans, etc., a preliminary permit should be exclusive to its holder. Section 8 provides that any successor or assign of the rights of a licensee shall be subject to all the conditions of the license under which such rights are held by the licensee. Mr. Kelley suggested that such conditions may have been so onerous as to have led to the failure and foreclosure of the operation under the original license, and that there should be some arrangement whereby they might be modified with the transfer of the license. He thought that the provision that the licensee shall convey to the United States free of cost its lands and rights-of-way, and right of passage through its dams or other structures, as might be necessary to complete navigation facilities, would be likely to be burdensome. The repealing clause stipulates that "no alterations, amendment or appeal shall affect any license heretofore issued under the provisions of this act, or the rights of any licensee thereunder," which language unwittingly shuts the license off from desired modification. Mr. Kelley therefore suggested the insertion of the word "adversely" before "any license."

Chairman Sims said that upon the expiration of the license the Government had three alternatives—to continue the license in the hands of the original licensee, to transfer it to another licensee, or to take the plant over. Un-

less the Government had some use for it for a strictly Governmental purpose, it would not take it over. And if nobody else wanted it, there would be no alternative but to leave it in the hands of the original licensee, and that upon his own terms, so that the grant was virtually one in perpetuity.

Mr. Kelley thought that renewals and replacements were not properly taken care of in the depreciation charge, and that there was likely to be a conflict between public officials that will be zealous in protecting the public interest and the building up of a surplus. The question of what is a fair return cannot be decided at the time of granting the license, and at the end of the term a manager who thought he had a comfortable surplus for distribution to his shareholders might find it wiped out entirely upon the ground that it had been earned by charging a rate which would yield more than a fair return. No other class of property is subjected to such "discrimination." There is no limit in the bill to the reserve fund that a promoter may be required to maintain. It is not quite clear in Section 5 just what rights are conferred upon the holder of a preliminary license.

Asked if he would give a municipality a better rate than another consumer, Mr. Kelley answered that in case there were a limited amount of power available he would give a municipality the preference as to service, but at the same rate.

Mr. Ferris, of the committee, pointed out that an amortized concern could keep going very cheaply. Mr. Kelley said that the tendency in all public utilities is to increase the amount of business done by decreasing the rate, and so to make more money. Further, he thought this bill more workable than any of the others which had been offered, and he would sooner see it adopted than none.

Miss Rankin, member of Congress from Montana, asked the witness about interlocking directorates, but obtained no admission that the Montana Power Co. was so interconnected with other interests. In reply to a question by Judge Raker as to price and service to small consumers, Mr. Kelley said that there was more power developed per capita in Montana than in any other part of the United States, and that the rates were the lowest. He said that he did not know of any water-power development in the United States that was paying more than 5 per cent. dividends. He justified the common stock, usually referred to as water, as a just return to the promoter for his enterprise.

Mr. Stuart's Paper

Charles E. Stuart, of the United States Fuel Administration, read a short paper dealing with the efforts of the Administration to conserve fuel, and suggested, as possible aid by the Government in this direction, assistance which may be rendered to the power system wherever interconnections may be deemed practicable and desirable, the rendering of financial aid for the enlargement of central-station systems to produce increased power, a radical fuel saving, or where there will be obviated what practically amounts to a duplication of investment, as in the case of the construction of isolated plants at this time; the necessary help to enable the complete systemization of the power situation of the entire country, the avoidance of duplication of investment, and the establishment at some centralized point, as at Washington, of a complete perspective of the entire power situation which would prevent any of the now recognized errors or abuses, such as exist in the duplication of investment.

John J. Harris, of Hardin, Mont., President of the Big Horn Canyon Irrigation and Power Co., resumed the stand to describe some of the preliminary operations which were necessary in working up a project of this kind.

A. P. Morrison, of the Electro-Metallurgical Co., Niagara Falls, spoke from the point of view of the user of power, to whom stability of service and of rates was of the first importance. While he is apparently taken care of by the public service commissions, the fact that his investment is entitled to protection against increase of rates or diminution of service has not been given the importance that it warrants. The investment of the user of power is greater than that of the furnisher of power. No power can be developed on a franchise revokable at will, and a revokable contract is of no use to the user of power. He suggested an amendment to the bill to prevent existing projects coming in under the law to get a chance to raise rates.

Commenting upon Mr. Kelley's testimony that a project should be amortized within the life of the license, Mr. Pierce said that the Priests Rapids development could not be developed under a law that required its amortization within 50 years, and in his opinion 95 per cent. of the available water powers could not.

S. P. Weston, representing the Water Power Legislation Committee of the American Newspaper Publishers Association, also questioned Mr. Kelley's position upon the question of amortization, and said that English companies always differentiated between stock and bond capital. He showed that the available paper-pulp material outside of private ownership in the United States was in the Western States contiguous to the undeveloped water power necessary for its manufacture. He was personally interested in a project which had obtained contract for $75,000,000 worth of print paper, but was unable to finance it on account of the Supreme Court decision in the Utah case.

A discussion ensued with regard to the provisions of recapture, and Mr. Ferris, of the committee, said it appeared that the Government would either have to take the projects over, or allow them to go on. It was practically a mandatory proposition. An inquiry by Representative Lever as to whether, in the opinion of the witness, the present tendency is not in the direction of Government ownership, was followed by a speedy adjournment.

Possible Conflict with State Laws

Augustus H. Houghton, representing the Conservation Committee of the State of New York, called attention to certain possibilities of conflict with the New York State laws, and suggested amendments which would avoid these. The term of five years provided for the executive was too short. It ought to be ten or fifteen years at least. Asked by Representative Taylor why the state had not gone about developing its water powers, the witness replied that the present commission does not believe in the state going into business and competing with existing companies.

William B. Matthews, of Los Angeles, which has its own municipal plant, believed that a license to a state or municipality should be perpetual, where the United States does not wish to take it back. The commission should not have jurisdiction or regulation over the rates and service of a municipal corporation, where the power is used for state or municipal purposes. He believed that the proposed law should not only give encouragement to private capital, but to states and municipalities. It is not likely that the National Government will be disposed to recapture and operate the project itself, and that a license once granted to a private corporation will be in effect perpetually. Under this condition, which would not be compatible with the public interest, the project should be recaptured and given to the municipality, or the municipality should have a prior right to it.

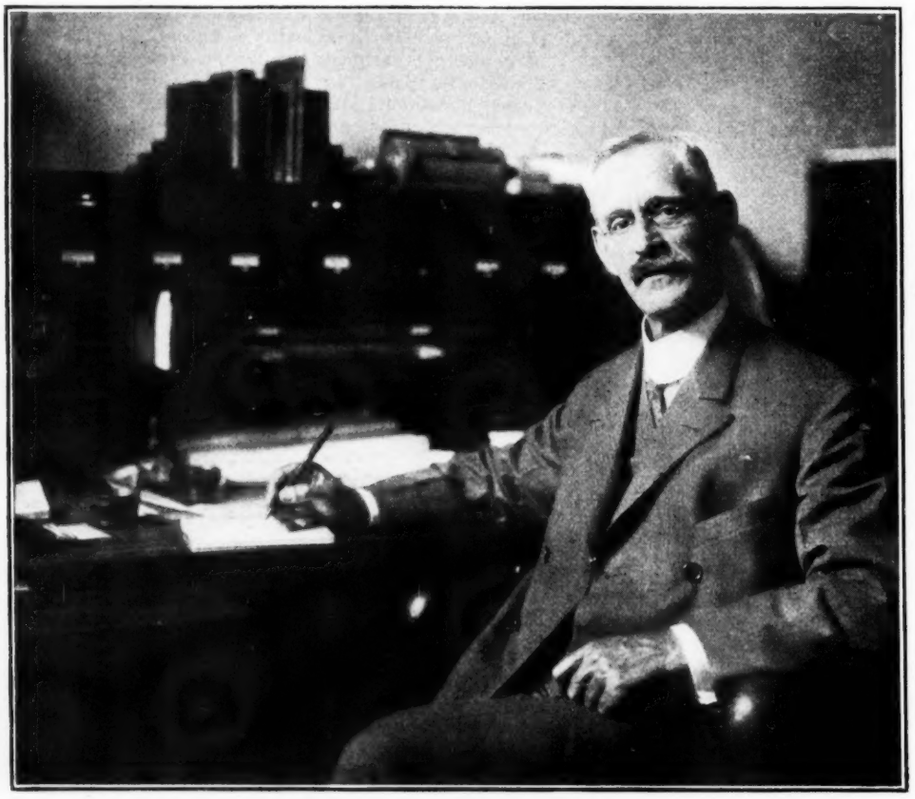
A few other witnesses remain to be heard, but the bill as a whole appears to meet with general commendation, and there is every evidence that it will be reported favorably without radical changes. How it will be received by the Senate, which has already passed the Shields Bill is not so evident.

The Netherlands Government has fixed maximum prices for coal and coke, says *Commerce Reports*, which are an advance on previous prices. They are stated in florins per hectoliter, but in American terms are equivalent to about $22 a ton for anthracite and $17 for bituminous coal; coke, about $10 a ton; coal briquets, about $25 a ton. The distribution is carefully regulated by cards in specified quantities, varying with the size and nature of the residence or the place of business. The quantity allowed, especially to residences, is much smaller than the amount they consumed in peace times.

John P. Sparrow, Dead

John Porterfield Sparrow, chief engineer, New York Edison Co., and for many years a member of the American Society of Mechanical Engineers, died at his home in Flatbush, Brooklyn, on Mar. 18, 1918. He was born in Portland, Me., Mar. 17, 1860; he died therefore at the age of fifty-eight.

Mr. Sparrow was an engineer by inheritance and education, his father, John Sparrow, being well known in the engineering field. His early education was obtained in the public schools of Portland, but this was largely supplemented by his father's teachings in physics, chemistry and engineering. In 1879, being interested in sugar manufacture, he was taken to Europe by his father to study the industry, and while there visited all the larger engineering works.



JOHN P. SPARROW, FOR MANY YEARS CHIEF ENGINEER, NEW YORK EDISON COMPANY, WHO DIED OF PNEUMONIA AT HIS HOME, BROOKLYN, N. Y., MONDAY, MARCH 18. MR. SPARROW HAD CHARGE OF THE DESIGNING AND BUILDING OF THE FAMOUS WATERSIDE POWER STATIONS. BESIDES HIS MANY CONTRIBUTIONS TO ENGINEERING, HE WAS A PHYSICIST OF NO MEAN ABILITY, MADE VALUABLE INVESTIGATIONS INTO THE MICROSTRUCTURE OF THE NONFERROUS ALLOYS AND DID MUCH PIONEER WORK IN COLOR PHOTOGRAPHY.

In 1880 he entered the Portland Co.'s locomotive and marine engine works as an apprentice. He served his apprenticeship and became a toolmaker and erector for that company, leaving it in 1888 to work for the Sprague Electric Co. During the next two years he acted as superintendent for the Sprague company in charge of construction of electric railways in the various parts of the country.

In 1890 he went to New Orleans for the New Orleans Electric Co. on construction work. In 1892 he joined the construction staff of the Edison General Electric Co. and was employed in building lighting and power plants for them and the Canadian General Electric Co. until 1895. He then joined the staff of the Construction Department of the Edison Electric Illuminating Co. of New York, and in 1898 became superintendent of construction, having charge of all the construction, which included the new Waterside Station, at that time the largest and most important construction of its kind which had been attempted. In 1906 he became chief engineer of The New York Edison Co. in charge of construction and operation, the position he held at the time of his death.

Mr. Sparrow became a member of the American Society of Mechanical Engineers in 1898, and has been an active member serving on various committees. At the time of his death he was chairman of the Committee on Standardization of Flanges and Pipe Fittings and had just finished the completed report on that subject. On Feb. 1, 1918, he was appointed chairman of the Advisory Board of the Power Test Committee. His work along these lines has been particularly valuable as his long experience, trained judgment and personal influence insured the reconciliation of conflicting interests.

In the Association of Edison Illuminating Cos. he was a member of the Committee on Steam Plants from 1906 up to the time of his death, and was chairman in 1910, 1912 and 1913. In this work his most valuable contributions were those in connection with coal testing and burning. Before the Edison Association he presented a number of papers on boiler-plant problems.

In the National Electric Light Association he was a member of the Committee on Prime Movers for a number of years.

Shortly after the United States entered the war, he made a number of tests for the Naval Consulting Board in connection with smoke abatement on ships as a protection against submarines.

Mr. Sparrow's hobbies were largely of an engineering character. In photography his work as an amateur rivaled that of many professionals, and he was one of the first to take up color photography. Microscopy, as a result of his early training, was always one of his chief aids, and his work on the photomicrography of lamp filaments is well known. In later years he turned to metallography in connection with the ever-present subject of the corrosion of condenser tubes, and assisted in the settling of important questions of heat treatment in the manufacture of this material. His knowledge of physical science was fundamental, and he was an adept in the mechanical handling and manipulation which is a necessity in research work of this kind.

Mr. Sparrow had a charming personality and his optimistic temperament, uniform courtesy and entire absence of contentiousness endeared him to a host of friends. He was held in affectionate regard by the officials of The New York Edison Co. to whom his passing away comes as a personal loss.

Struggling with Poor Coal*

By George E. Wood
Mechanical Engineer, Connecticut Company

The Connecticut Co. has six generating plants ranging in capacity from 16,500 kw. to 350 kw., which supply the entire system with energy, with the exception of the New Britain, Waterbury, Norwalk and Stamford divisions, the latter sections being supplied with purchased power. The total installed capacity is 40,000 kw., of which 12,000 kw. is held in reserve. The Bridgeport, Hartford and New Haven plants supply 85 per cent. of the total output.

Since the latter part of 1916 the quality of the coal has been gradually deteriorating and at present it is a continual struggle to keep the plants operating, to say nothing of trying to improve the efficiency. If good coal could have been obtained last year a 10 per cent. increase in efficiency over 1915 would have been attained in fuel consumption, due to new and reconstructed plants. However, as the fuel was below standard, the actual tonnage consumed increased 24 per cent. over that required in 1915 and 31 per cent. over what would have been required in 1917 with standard-quality coal. It appears that with good-quality coal 7 per cent. less cars would be required on the railroads compared with the rolling stock needed to handle what one of the company's engineers terms "black asbestos."

Soon after the first lot of poor coal was received the tonnage consumed began to rise. The company engaged the services of a competent combustion engineer, who instructed the various boiler-room engineers in the vagaries of combustion under the conditions attending the constantly changing grades of coal. Without his aid the tonnage consumed would have been considerably greater.

Plants Were Designed for High-Grade Fuel

It is possible economically to consume low-grade fuels of uniform quality and corresponding low price, where the furnaces are designed to suit the fuel, with ash-removal machinery capable of meeting the heavier demands and, of course, suitable unloading facilities. When, however, a plant is designed for a high-grade coal and the fuel actually used is worse than a uniform low-grade product, there is no doubt as to what the results will be. Thus, one consignment of fuel received would pack down on the tuyeres so solidly that the combined capacity of all the blowers in the plant could not force sufficient air through to allow it to burn. To attain any semblance of combustion, it was necessary to apply slice bars through the observation doors, and even then interruptions of varying duration could not be avoided.

About the time this coal had been "run through the furnaces" and the firemen were able to attain better results, the next shipment would be received. As this new coal followed the last of the previous shipment through the bunkers, the firemen would find that with the usual plenum in the wind boxes, the coal would be blown over onto the dump plates and pile up in a red-hot mass to a depth of three to four feet. Often the entire dump plate and shaft twisted out of shape so badly that they had to be entirely renewed. Within a few days some coal was received that would burn nicely for about an hour, after which it could be seen gradually to shut off the air supply. The shaking grates could not be moved more than one-half inch, and a slice bar thrust in along the grates would lift nearly half the fire up from the grate. Steam jets in the ashpits were of little assistance in preventing this "india rubber" like clinker, and after a short time the plant was shut down for two hours. Section breakers and feeder switches were relocated to relieve the load on the plant, and the arrival of more coal made it possible to resume operation under these conditions. It also gave the operators a chance to take the boiler out of service and clean the heating surfaces, which were covered with soot and slag.

This boiler had been in service continuously for three weeks and as a result of the cleaning five barrows of stalactites were taken out, in spite of the fact that the boiler was dusted daily. If the boiler had not been taken out of line at the time, a deposit would have formed which practically would have closed the gas passage.

An investigation of the records of fuel analysis shows samples containing 24 per cent. of volatile hydrocarbons, 45 per cent. fixed carbon, 29.8 per cent. ash and 3 per cent. sulphur, with a calorific value of 10,300 B.t.u. per lb. One particular cargo "passed through the furnace" with the ash running close to 37 per cent. by weight. The average for all coal received in 1917 was but little better than the case cited.

Poor Coal Increased Maintenance

In addition to serious interruptions, great trouble has been experienced from stoker failures. These occur at some plants at the rate of two a day, and on this account it is impossible to repair them in a first-class manner. This is not to be wondered at when one stops to think of the foreign substances found in the coal, such as traprock, short bolts, coupler pins, slate, slag, brickbats and even pig iron. The smaller pieces pass through the crushers and into the furnaces, in spite of the vigilant eye of the weigh-hopper man, and then there is a cracked bearing cap, broken bracket or sprung crankshaft. Stoker repairs are tripled, and the stock of repair parts seriously depleted.

The poor quality of coal has added to the difficulties of the labor situation. It has been particularly difficult to retain the ashmen and firemen. For every carload of ashes taken out of the ash hoppers during 1915 three carloads are taken out today.

An inspection of the operating records shows that the total unit cost of production for 1917 was 1.48c., or double the cost for 1915. Of this, 82.5 per cent. is due to fuel cost. Comparing the total amounts for the fiscal years 1915, 1916 and 1917, the total cost of production for 1915 was $630,000; for 1916, $745,000 (an increase of 18 per cent. for 8 per cent. increase in production), and in 1917, $1,187,500, an increase in production of 11 per cent. and a cost increase of 90 per cent. In 1915 the total amount paid for fuel for the six plants was $425,000, or 67 per cent. of the total production cost. In 1916 it was $520,000, or 70 per cent., and in 1917 it was $976,900, or 83 per cent., which is more than twice that paid under normal conditions. Labor shows an increase of $33,000 and maintenance an increase of $70,000. It is not unreasonable to state that fully 90 per cent. in the company's increased cost of power is due solely to the fact that the road is paying for, but not getting, coal.

Company Plans Additional Equipment

Several plans are afoot to relieve conditions in the near future. The most important is the installation of additional ash-handling facilities and coal-handling equipment and storage space. In the last case it is proposed to discharge sufficient coal at each plant between the dates of Apr. 1 and Nov. 1, 1918, to take care of the needs during this period and have stored at the latter date sufficient coal to carry the plants through until the spring of 1919. To do this it will be necessary to receive in 214 days 150,000 gross tons of coal, which is equivalent to unloading 692 tons per day. To attain this result the Connecticut Co. will have to expend between $200,000 and $300,000. For the New Haven power plant it will have to furnish additional storage space. In the Hartford plant the same thing pertains, and in the Bridgeport plant another dock will have to be built, with facilities for reclaiming the coal and getting it into the bunkers. To put in this coal and get it into storage about $500,000 will have to be expended. A quotation received in this connection for an eight-wheel locomotive crane with 50-ft. boom and a 1½-cu.yd. bucket was $18,458, compared with $7,650 in 1915. This plan will relieve much anxiety as to coal shortage next year and will relieve traffic congestion.

The company has exerted every effort to reduce fuel consumption to a minimum. Strict attention has been paid to turning off all unnecessary lights and electric heaters; the skip-stop system of operation has been inaugurated; a vigorous campaign in power saving has been instituted with good results.

*Abstract of address before New England Street Railway Club, Boston, Feb. 18, 1918.

The National Chamber of Commerce Vote on the Water Powers

1. That Federal legislation encouraging the development of water powers should at once be enacted. Adopted by the almost unanimous vote of 1324 to 6.

2. That authority to grant permits should be vested in an administrative department. Carried by a vote of 1253 to 17.

3. That the permit period should be at least fifty years, any shorter period being at the applicant's option. In favor, 1216; opposed, 42.

4. That tolls should attach only to use of public lands or benefits derived from headwater improvements. Adopted by vote of 1191½ to 40½.

5. That permittees should be entitled to acquire the right to use public lands forming only a small and incidental part of the development. Carried by a vote of 1210 to 25.

6. That recapture should be exercised only upon payment of fair and just compensation. In favor, 1234; opposed 25.

7. That if recapture is not exercised, the investment of the permittee should be adequately protected. Adopted by a vote of 1226 to 26.

8. That rates and service should be regulated by state commissions where the service is intrastate, with Federal regulation only where several states are directly concerned and do not agree or there is no state commission. Carried by a vote of 1177 to 57.

9. That if any jurisdiction to regulate the issuance of securities is exercised, it should be solely by the state. In favor, 1114; opposed, 117.

10. That no preference should be granted as between applicants amounting to a subsidy from the government creating unequal competition. Adopted by a vote of 1191 to 38.

Navy Engineers to Train at Stevens

The Navy Department, after consultation with President Humphreys, has designated the Stevens Institute of Technology, Hoboken, N. J., as the headquarters for the new United States Naval Steam Engineering School for training engineer officers for the Naval Auxiliary Reserve.

This school is the only one devoted to training engineer officers for steam-engine service, and is a branch of the large training school now located at Pelham Bay Park, New York. There is at Pelham, in addition to the school for general training of enlisted men, an Officers' Material School, Naval Auxiliary Reserve. Both the school at Pelham and the engineer officer school at Stevens are under the supervision of the supervisor, Naval Auxiliary Reserve. The education of the engineer officers at Stevens is directed by Prof. F. L. Pryor, of Stevens, who has been appointed by the Navy Department, with the approval of President Humphreys, civilian director.

It is contemplated to make a five-months course for the training of an officer; one month to be devoted to military and ship duties training at Pelham, one month at Stevens to receive the preliminary requirements and duties of an engineer, one month in inspection and repair duties at local shipyards, machine shops and boiler shops, one month at sea in the engine room of different type boats, and one month subsequent training and examination at Stevens. It is expected to have about one hundred men in each of these divisions, or five hundred in all.

Three of the divisions will be quartered in barracks now in the course of construction on the college grounds at the corner of Sixth and Hudson Sts., adjoining the Carnegie Laboratory of Engineering. The school divisions will attend classes in the lecture rooms of the college and will take their meals at the college mess hall at Castle Stevens.

The instructors for the school, with the exception of the civilian director, will be regularly appointed commissioned officers of the United States Naval Auxiliary Reserve, selected particularly for their especial work.

Quotas are furnished for this school by the various Naval Districts throughout the country as outlined by the Navy Department and are required to meet the following qualifications: (a) Men of ability and officer material; (b) age 21 to 30, inclusive; (c) completed high-school course and graduate of engineering course at a recognized technical school or an equivalent of the above; (d) must be regular Navy, N. N. V., or N. R. F. (any class) for general service; (e) physically qualified for line officer—standard of regular Navy.

Men may be newly enrolled specifically for this course by applying to their Naval District enrolling officer and then be transferred by the commandant of that district to the school in his weekly quota.

That the students will be required to perform hard work is evidenced by the routine of duty which has been posted as follows: 6, reveille; 6:15, assembly; 7, breakfast formation; 7:15, breakfast; 8:15, study call; 9:45, retreat; 10, study call; 11:30, retreat; 12:15, dinner formation; 12:30, dinner; 1:15, study call; 2:45, retreat; 3, study call; 4:15, retreat; 4:30, drill; 5:30, retreat; 6, supper formation; 6:15, supper; 7, study call; 9:30, retreat; 10, taps.

It was expected that the first course would start on Mar. 25 and the second course about Apr. 22. After the barracks are completed, a unit of 25 men will be enrolled each week, and after the school is in full operation about one hundred engineer officers will be graduated each month. The rank of the successful students will be that of ensign; the unsuccessful students will be given appropriate ratings by the Supervisor, Naval Auxiliary Reserve and transferred to Pelham Park for general detail.

Turbine Propelling Units Wanted

Quotations are requested by the Emergency Fleet Corporation, Washington, D. C., on one hundred turbine propelling units, to be constructed in accordance with the following general specifications: (1) Capacity, 3000 s.hp.; (2) propeller speed, 90 r.p.m.; (3) steam pressure, 210 lb.; (4) superheat, 50 deg. F.; (5) vacuum, 28 in.; (6) each propelling unit is to consist of a high-pressure turbine and a low-pressure turbine with backing turbines, and a double herringbone reduction gear and housing, and is to be complete with all necessary attachments including a forced-oil lubricating system, cross-connecting piping, overspeed emergency valve and other necessary appurtenances. The propelling unit shall meet the requirements of Lloyd's and of the American Bureau of Shipping.

Segregated prices are to be stated for complete sets of spare parts. No auxiliary equipment, such as condensers and circulating pumps, is to be provided with the main propelling unit.

The time of delivery is of prime importance. Bidders are to state in proposal the earliest possible delivery of complete units and are to tabulate a complete schedule of deliveries which are to be guaranteed.

Proposals are to be complete in every respect and are to be accompanied by a full set of specifications and general and detail drawings showing the equipment contemplated.

Bidders are to state the type of turbine proposed; the turbine speed; the steam consumption at ¼, ½, ¾, full load and 1¼-load (in pounds of steam per s.hp.-hr.); gear efficiency; the length, width, height and weight of the propelling unit; the sizes of the steam and exhaust pipes; and a list of all gages, valves, strainers, case-hardened wrenches, wrench-boards, packing, lifting bolt, and similar devices supplied with the unit. The name of manufacturer and the point of manufacture and delivery are to be stated.

It is contemplated that manufacturers will bid on their standard turbine propelling equipment complete in every respect. Proposals must be submitted within ten days after date hereof. No bidding bond is required.

Alternative proposals are expressly desired on equipment conforming generally to the specifications of this inquiry. Alternatives will be received upon turbines operating at a shaft speed of 100 r.p.m.

Washington, D. C., Mar. 23, 1918.

New Publications

THE PETROLEUM AND NATURAL GAS REGISTER 1917-1918. Published by The Oil Trade Journal, New York. Size 9 x 11½ in.; 548 pages. Price, $12.

This is a representative catalog of the trade and is a collection of much valuable information about the petroleum and natural-gas industries of the United States, Canada and Mexico, giving names of officers, capital stock, location of properties and other valuable data, together with financial statements that fit in with facts as to organizations and operations. The text is divided into lists of refiners of petroleum; manufacturers and compounders of lubricating oils, greases, petroleum, etc., and gives marketers and jobbers grouped under Eastern, Central and Southern, and Western States; producers of petroleum, Eastern and Central States, Oklahoma and Kansas, Texas and Louisiana, and Western States; also lists of oil pipeline companies, casinghead-gasoline manufacturers, natural-gas producers and distributers, manufacturers of and dealers in supplies and equipment for the oil and natural-gas industries, and a directory of officers and members of the oil and gas associations and clubs in the United States. The arrangement and classifications of data are well planned for enabling the reader to obtain the desired information with little difficulty.

Personals

Joseph Harrington, of Chicago, the well-known combustion engineer, has been elected vice president and advisory engineer of the Chicago Superheater Co. E. A. Geoghegan has resigned.

A. F. Ausman, formerly vice president of McMaster-Carr Supply Co., of Chicago, is now Chicago district manager of Nagle Corliss Engine Works, of Erie, Penn., with offices in the Monadnock Block.

Frederick L. Ray, past president of the National Association of Stationary Engineers, has resigned as chief engineer of the Merchants Heat and Light Co., of Indianapolis, Ind., to take a corresponding position with the Erie Lighting Co., Erie, Penn.

A. D. Alexander has purchased the Pittsburgh (Penn.) office of the Richard D. Kimball Co., consulting engineers, and will continue the business under his own name. Mr. Alexander has been resident engineer in charge of the Kimball office for the last three years and was formerly engineer with the Pittsburgh Board of Public Education.

C. H. Van Hooven, claim agent of the Manila, (P. I.) Electric Railroad and Light Co. who has been visiting the United States for the purpose of consulting with officers of the J. C. White Management Corporation, New York, the operating managers of the Manila Co. is returning to the Philippines by way of Hawaii and Japan. While in the United States, Mr. Van Hooven also devoted considerable time to inspecting the claim methods of electric railways in a number of large cities. He has been connected with the Manila Electric Railroad and Light Co. for the last ten years. He was recently admitted to the Philippine bar, having successfully completed the law course at the Manila University.

Miscellaneous News

The Wentworth Institute, Boston, Mass., held its seventh public exhibition of work done in the various departments on Mar. 21. It appealed especially to persons interested in modern methods of training young men for skilled occupations in the trades and industries. A short, intensive 12-weeks' full-time day course in military engineering will be given at the Institute, in coöperation with First Corps Cadet Veteran Association, April 8 to July 1.

Steam Power Plants Close to Save Oil—All but one of the steam plants of the three big electric power companies operating in San Francisco closed down on the night of Mar. 19 and will remain closed for the remainder of the season if possible. The Pacific Gas and Electric Co., Great Western Power Co. and the Sierra & San Francisco Power Co., have inter-connected their heavy power lines and plants and the one operating steam plant will act as a standby in case of accident to the transmission lines from the hydro-electric plants of the three companies. The shutting down of the steam plants is in line with the program adopted for the conservation of fuel oil. The Potrero plant of the Pacific Gas and Electric Co. will act as the standby at night and the steam plants of the other two companies will alternate as standbys during the day, each plant taking an eight-hour shift.

Business Items

The H. W. Johns-Manville Co. has opened a branch office at 1015 A Street, Tacoma, Wash.

The Duquesne Electric and Manufacturing Co., of Pittsburgh, Penn., announces the opening of a branch office at 230 South La Salle St., Chicago.

The Vulcan Soot Cleaner Sales Co. has transferred its general sales office from 230 So. La Salle St., Chicago, to Du Bois, Penn., in order to bring the sales, factory and engineers in immediate touch. G. L. Simonds is in charge.

The American Thread Co.'s general engineering department will be transferred from the Merrick Mills at Holyoke, Mass., to the company's head office at 260 West Broadway, New York City, on Apr. 1. Malcolm Curry, general engineer, Kenneth B. Millett, assistant general engineer, and A. C. Richardson will be located at this latter office.

The Jos. W. Hays Corporation, of Michigan City, Ind., has purchased the business and good will of the Combustion Appliance Co., of Chicago, manufacturers of the Hays line of combustion testing apparatus. The general offices will be maintained at Michigan City. Following are the authorized representatives of the company: For New England States, Eagle Oil and Supply Co., 45 India St., Boston, Mass.; New York City and vicinity, Stephen H. Payne, 30 Church St., New York; Pennsylvania, New Jersey, Delaware, Maryland, Virginia and West Virginia, the Paul B. Huyette Co., 5 So. 18th St., Philadelphia, Penn.; Ohio, the Hays Engineering Co., 614 Commerce Bldg., Columbus, Ohio; Indiana, Acme Engineering Agency, 423 Fletcher-American Bank Bulding, Indianapolis, Ind.; Illinois and Wisconsin, The Hays Instrument Co., 1426 Consumers Bldg., Chicago, Ill.; Minnesota, Montana, North and South Dakota, The R. B. Whitacre Co., 205 S. Robert St., St. Paul, Minn.; Oklahoma and Texas, The Chas. W. Hays Co., Tulsa, Okla.; Louisiana and Mississippi, Henry J. Malochee, 917 Hennen Bldg., New Orleans, La.; The Pacific Coast, The Braun-Knecht-Heimann Co., 576-584 Mission St., San Francisco, Cal., and The Braun Corp., 363-371 New High St., Los Angeles, Cal. Agency arrangements will be considered with aggressive and responsible people in unoccupied territory. E. A. Acers is president and general manager of the Jos. W. Hays Corporation.

NEW CONSTRUCTION

Proposed Work

Vt., Brattleboro—The Twin States Gas and Electric Co. has been granted permission by the Public Service Commission to build transmission lines in Brattleboro, Bennington and St. Johnsbury, and to improve its power plant at West Dummerstown. W. H. Richardson, local mgr.

Mass., Adams—The Renfrew Manufacturing Co. plans to build a power plant on Columbia St.

Mass., Fall River—The stockholders of the Fall River Electric Co. will petition the Gas and Electric Light Commissioners for authority to increase its capital stock from $1,400,000 to $2,100,000; proceeds to be used for paying its outstanding indebtedness, also for new high tension transmission system to be built over the Taunton River. A. H. Kimball, 85 North Main St., Gen. Mgr.

Mass., Millbury—The New England Power Co., 18 Grafton St., Worcester, is having surveys made for the construction of a high tension transmission line from here to Webster. S. C. Moore, Gen. Mgr.

Mass., Worcester—The W. H. Sawyer Lumber Co., 26 Lincoln St., is having plans prepared for the construction of a power house in connection with its new plant. Estimated cost, $70,000.

N. Y., Buffalo—The J. H. Williams Co., 400 Vulcan St., plans to increase the capacity of its power plant during the year.

N. Y., Lockport—The Lockport Light, Heat and Power Co., controlled by the United Gas and Electric Co., 61 Broadway, New York, has been authorized by the Public Service Commission to issue $106,700 capital stock; proceeds to be used for paying the outstanding indebtedness. J. A. Perkins, Gen. Mgr.

N. Y., New York—The Interborough Rapid Transit Co. has filed plans for the construction of a 3-story, 40x41 ft. transformer station on 74th St. east of Ave A. Estimated cost, $12,900. G. H. Pegram, Ch. Engr.

N. Y., Rochester—The Rochester Railway, Light and Power Co. has been granted permission by the Public Service Commission to issue $2,000,000 capital stock to cover the cost of the recent improvements in the equipment of its Genesee River hydraulic plant. T. H. Yawger, 34 Clinton Ave., Supt.

N. Y., Sandlake—The McLaren Knitting Co. has applied to the Town Board for a franchise to construct an electric transmission line to enable it to secure electricity to operate its mills here.

Penn., Chester—The Delaware County Electric Co., Lansdowne, controlled by the Philadelphia Electric Co., 1000 Chestnut St., Philadelphia, is building a large steam power station on the Delaware River here. A. R. Granger, Mgr.

Penn., Philadelphia—The Bureau of Supplies and Accounts, Navy Dept., Wash., will soon receive bids for furnishing at Navy Yard, here, under Schedule No. 1725, plain enameled magnet wire; Schedule No. 1726, 300 counter scales; Schedule No. 1727, standard steel bolts.

Del., Bowers—W. E. Kelly is interested in a project to organize a company to install and operate an electric light plant here.

Md., Ellicott City—The Town Commissioners plan to issue bonds for the construction of an electric-light plant.

Md., Pylesville—The Fawn Grove Light and Power Co., Fawn Grove, Pa., will construct a new concrete dam at their Eden Mills plant on lower Deer Creek near Pylesville, about 300 ft. long to carry 30 ft. of which only 16 ft. will be built this season. The company will install water wheels and one 125 kva. generator, 3 phase, 60 cycle, 2200 volts with exciter, switchboard, etc., and require from four to seven miles of No. 6 copper transmission wire. Work will be done by day labor. William Russell Smith Co., York, Pa., Engr.

N. C., Southport—J. G White & Co., 43 Exchange Pl., New York, has purchased property of Southport Electric Light and Power Co. The new owners plan to spend about $20,000 for improving same.

S. C., Charleston—Charleston Consolidated Railway and Lighting Co. plan to increase the capacity of its power house on Meeting St. P. H. Gadsden, Pres.

Ga., Jackson—City plans to improve the electric-light plant to include rebuilding 1½ mi. of pole line and installation of high pressure centrifugal pump, 2 stage, electrically driven. W. E. Merck, Gen. Mgr.

Ala., Ensley—The Tennessee Coal, Iron and Railway Co. will install a 7500 k.w. generator in power station No. 1 at the Ensley blast furnaces.

Ala., Mobile—The Chickasaw Shipbuilding Co. is constructing a power plant at its yards, here. Estimated cost $750,000. The plant will have two 4000 k.w. turbo generator units and three air compressors of 8800 cu.ft. per minute will be installed. Equipment has been purchased.

La., Oak Grove—City plans to install an electric lighting plant soon. Address L. Grathwell, Oak Grove.

Ky., Graham—The W. G. Duncan Co., Greenville, plans to construct a 75x100 ft. power house, also build from 4 to 5 mi. transmission line to connect Greenville, Luzerne and Depoy. Material and equipment purchased.

Ky., Hazard—The Perry Coal and Lumber Co. plans to install an electrically operated plant for a coal development on Louisville & Nashville Railroad in Perry County.

Ky., Indian Bottom—The Middle West Coal Co. will receive bids until Mar. 30, for the erection of a power plant midway between here and Jeremiah. Estimated cost, $50,000.

Ind., Attica—The city plans to rebuild its electric-light and water-works plants which were recently destroyed by fire with a loss of $60,000. G. McDonald, Mgr.

Ind., Gary—The Gary Street Railway plans to construct a new power station on 11th Ave.

Ind., Indianapolis—Bids will be received by the Board of Trustees of Indiana University, Bloomington, for the construction of a 1-story, 88x91 ft., brick and reinforced concrete power house in connection with the new medical building to be built on West Michigan St. Bids will be received at the same time for furnishing the electric equipment, boilers and heating equipment, refrigerating and ice-making equipment, hot water equipment, heating and ventilating apparatus, electric wiring, etc., for both buildings. R. F. Daggett, 956 Lemcke Annex, Arch.

Ill., Biggsville—The Biggsville Light Co. plans to change its system to alternating current, single phase, and extending its service to two small towns and farms along the line. A 75 kva. single phase, 2200 or 1199 volt machine will be required. D. W. Lee, Vice-Pres.

Ill., Charleston—Council authorized $20,000 bond issue, proceeds of which will be used for improving electric-light plant and water-works system.

Ill., Mt. Olive—City will hold an election Apr. 16 to vote on $8000 bonds to be used for the improvement of the electric-light plant. It is also proposed to equip the water-works pumping station with electrically operated machinery. W. S. Merkle, Federal Reserve Bank Bldg., St. Louis, Mo., Engr.

Ill., Rockford—City will hold election in April to vote on $500,000 bonds to install an electric-light plant.

Iowa, Boyden—Veenschoten Bros., Boyden, have been granted a franchise by the Board of State Railroad Commissioners to construct and operate electric transmission lines on certain highways and roads in Sioux County for a period of 25 years.

Iowa, Dubuque—The Chicago, Milwaukee and St. Paul Railway plans to improve the power plant at its shops here. Estimated cost, $50,000. C. F. Loweth, Chicago, Ill., Ch. Engr.

Iowa, Lanesboro—City will hold election March 8 to vote on $7000 bonds, proceeds will be used for building electric-light plant.

Ia., Ossian—Harry Bullard, owner of the local electric light and power plant, has sold same to A. G. O'Rear of Mason City. The new owner plans to improve the same.

Minn., Iona—City plans to install electric-light and power plant to cost approximately $10,000.

Kan., Chapman—The United Telephone Co. is building a new transformer station here. Plans are also being considered by the company for other improvements.

Kan., Lawrence—The Bowerstock Mills and Power Co., Lawrence, plans to build a large boiler house soon. R. C. Jackman, Mgr.

Kan., Oakley—Plans are being considered by the city for the construction of a transmission line from here to Colby to secure electricity to operate the local system.

Kan., Ottawa—City plans to build a transmission line on South Willow St., from 11th to 15th St., thence on 15th St. from Willow to Locust Sts. W. O. Myres, Supt.

S. D., Miller—The City Council contemplates calling an election to vote on $30,000 bonds to install an electric-light and power plant.

Ark., Helena—The Helena Gas and Electric Co. plans to enlarge its plant and install new machinery.

Tex., Bryan—City will purchase additional transformers for its electric-light and power system.

Tex., San Angelo—Plans are being considered by the Interstate Corporation, 141 Broadway, New York, for extending its electric transmission system now running from San Angelo to Ballinger to Coleman and Brownwood. E. Burrow, San Angelo, Ch. Engr.

Okla., Hominy—The Hominy Ice, Light and Power Co. has purchased an additional electric generating unit consisting of a 150 h.p. gas engine directly connected to a 100 k.w., 3 phase, 60 cycle, 2300 volt generator for its plant here

Okla., Laverne—City will spend $13,000 to construct an electric-light plant. Address The Mayor. Noted Dec. 18.

Okla., Miami—City will expend about $45,000 to improve and extend its electric-light plant. Address The Mayor. Noted Nov. 6.

Okla., Shattuck—City plans to spend between $20,000 and $30,000 to build electric-light plant to develop 150 to 300 h.p. A. C. Oliver, Mayor. Burns & McDonnell, Interstate Bldg., Kansas City, Mo., Engr

Colo., Colorado Springs—The Golden Cycle Co. has under consideration the construction of an electric lighting plant.

N. M., Des Moines—Village Trustees will call an election to vote on $50,000 bonds to purchase the local electric-light plant and water-works system and improve and extend same.

Ariz., Yuma—The City plans to improve and enlarge the electric-light and power plants and the water-works system. Among improvements contemplated is the erection of an electric transmission line of 6600 volts to supply nearby ranches. Fred Kuecke, Supt.

Wash., Tacoma—City will hold an election soon to vote to purchase either a completed power plant at a cost of approximately $5,000,000 or a site on which a plant may be built. L. Evans, Gen. Supt. Noted Feb. 8.

Wash., Tacoma—City is having plans prepared by its Electrical Department for the erection of a substation. L. Evans, Gen. Supt

Wash., Tacoma—Light and Water Department plans to replace conduits underground from Nisqually sub-station at 23rd and C Sts., to Winthrop Ave. New circuits will be for shipyards and tide flats. L. Evans, Gen. Supt.

Calif., Hanlon—The Imperial Irrigation District, Masonic Temple Bldg., El Centro, plans to construct a new power line from here to point on the Alamo. Estimated cost, $11,000.

Calif., Los Angeles—The Public Service Commission authorized the leasing from the Harbor Commission of a tract of land on the east side of the Harbor Blvd. to be used as a site for a sub-station for the municipal power system. The site adjoins the property of the Los Angeles Dry Dock and Shipbuilding Co. A. Scatter good, Ch. Electrical Engr.

Calif., Los Angeles—The Riverside-Southern Sierras Power Co., 611-12 Lymes Bldg., Denver, Colo., plans to expend about $279,000 for reconstructing one of its main transmission lines, extending for distance of 60 mi. from hydro-electric plant located on Rush Creek. V. Presto, Riverside, Gen. Mgr.

N. B., Woodstock—The Woodstock Electric Railway Light and Power Co. plans to improve its plant here this summer. Improvements contemplated include installation of Hercules turbine, type D of Holyoke Manufacturing Co., developing 137½ h.p. at 13 ft. head, belt connected to a Westinghouse generator in synchronism with two generators. C. D. Johnson, Mgr

Ont., London—The Helena Costume Co., 190 King St., is in the market for a 60 k.w., 110 volts, 680 r.p.m., compound wound, direct current generator.

CONTRACTS AWARDED

Mass., New Bedford—The Union Street Railway has awarded the contract for the construction of the superstructure of a 2-story, 98x126 ft., brick and steel building to be used as a boiler house and turbine room, to J. W. Bishop Co., 109 Foster St., Worcester. Estimated cost, $135,000.

N. J., West Orange—T. A. Edison, Inc., Lakeside Ave., has awarded the contract for the construction of a 1-story, 100x100 ft. reinforced concrete power plant, to the Underpinning and Foundation Co., 270 Broadway, New York City. Noted Oct. 23.

Penn., Nanticoke—The Board of Managers of the State Hospital, has awarded the contract for a 1-story, 50x65 ft. power house, to John Curtis & Co., 1 Hickory St., Wilkes-Barre.

Penn., Reynolds—The Atlas Powder Co. has awarded the contract for the construction of a power plant here, to A. Breslin, Summit Hill.

O., Salem—The Salem Lighting Co. has awarded the contract for a 1-story, 31x40 ft. boiler house addition, to Walker & Curley Co., East End Trust Bldg., Pittsburgh, Pa. Estimated cost, $30,000.

Ind., Robey—The Western Products Co., Robey, has awarded the contract for the construction of a 1-story power house, to the Industrial Building Co., 38 South Dearborn St., Chicago, Ill. Estimated cost, $5600.

THE COAL MARKET

Boston—Current quotations per gross ton delivered alongside Boston points as compared with a year ago are as follows:

ANTHRACITE

	Circular† Mar. 28, 1918	Individual† Mar. 28, 1918
Buckwheat	$4.60	$7.10—7.35
Rice	4.10	6.65—6.90
Boiler	3.90	.....
Barley	3.60	6.15—6.40

BITUMINOUS

Bituminous not on market.

Pocohontas and New River, f.o.b. Hampton Roads, is $4, as compared with $2.85—2.00 a year ago.

*All-rail to Boston is $2.60. †Water coal.

New York—Current quotations per gross ton f.o.b. Tidewater at the lower ports* as compared with a year ago are as follows:

ANTHRACITE

	Circular† Mar. 28, 1918	Individual† Mar. 28, 1918
Pea	$5.05	$5.80
Buckwheat	4.30—5.00	5.50—5.80
Barley	3.25—3.50	4.00—4.25
Rice	3.75—3.95	4.50—4.80
Boiler	3.50—3.75	.....

Quotations at the upper ports are about 5c. higher.

BITUMINOUS

	F.o.b. N. Y. Harbor	Mine
Pennsylvania	$3.65	$2.00
Maryland	3.65	2.00
West Virginia (short rate)	3.65	2.00

Based on Government price of $2 per ton at mine.

*The lower ports are: Elizabethport, Port Johnson, Port Reading, Perth Amboy and South Amboy. The upper ports are: Port Liberty, Hoboken, Weehawken, Edgewater or Cliffside and Guttenberg. St. George is in between and sometimes a special boat rate is made. Some bituminous is shipped from Port Liberty. The ratte to the upper ports is 5c. higher than to the lower ports.

Philadelphia—Prices per gross ton f.o.b. cars at mines for line shipment and f.o.b. Port Richmond for tide shipment are as follows:

	Line		Tide	
	Mar. 28, 1918	One Yr. Ago	Mar. 28, 1918	One Year Ago
Pea	$3.75	$2.80	$4.65	$3.70
Barley	2.15	1.85	2.40	2.05
Buckwheat	3.15	2.50	3.75	3.40
Rice	2.65	2.10	3.65	3.00
Boiler	2.45	1.95	3.55	3.15

Chicago—Steam coal prices f.o.b. mines:

Illinois Coals	Southern Illinois	Northern Illinois
Prepared sizes	$2.65—2.80	$3.35—3.50
Mine-run	2.40—2.55	3.10—3.25
Screenings	2.15—2.30	2.85—3.00

Smokeless Coals	So. Ill., Pennsylvania and W. Va.	Pocohontas, Hocking, East Kentucky and West Va. Splint
Prepared sizes	$2.60—2.85	$2.85—3.35
Mine-run	2.40—2.60	2.60—3.00
Screenings	2.10—2.55	2.35—2.75

St. Louis—Prices per net ton f.o.b. mines a year ago as compared with today are as follows:

	Williamson and Franklin Counties Mar. 28, 1918	Mt. Olive & Staunton Mar. 28 1918	Standard Mar. 28, 1918
6-in. lump	$2.65-2.80	$2.65-2.80	$2.65-2.80
2-in.-lump	2.65-2.80	2.65-2.80	2.65-2.80
Steam egg	2.65-2.80	2.65-2.80	2.65-2.80
Mine-run	2.40-2.55	2.40-2.55	2.40-2.55
No. 1 nut	2.65-2.80	2.65-2.80	2.65-2.80
2-in. screen	2.15-2.30	2.15-2.30	2.50-2.65
No. 5 washed	2.15-2.30	2.15-2.30	2.50-2.65

Birmingham—Current prices per net ton f.o.b. mines are as follows:

	Mine-Run	Lump & Nut	Slack and Screenings
Big Seam	$1.90	$2.15	$1.65
Pratt, Jagger, Corona	2.15	2.40	1.90
Black Creek, Cahaba	2.40	2.65	2.15

Government figures.

Individual prices are the company circulars at which coal is sold to regular customers irrespective of market conditions. Circular prices are generally the same at the same periods of the year and are fixed according to a regular schedule.

Prices—Materials and Supplies

These are prices to the power plant by jobbers in the larger buying centers east of the Mississippi. Elsewhere the prices will be modified by increased freight charges and by local conditions.

ELECTRICAL SUPPLIES

KNIFE SWITCHES—Following are net prices each in cities named for knife switches mounted on slate base, front connected, punched clip type, 250 volts:

	30 Amp.	60 Amp.	100 Amp.	200 Amp.
D. P. S. T. fuseless	$0.52	$0.93	$1.90	$3.42
D. P. S. T. fused	.81	1.37	2.70	5.14
D. P. D. T. fuseless	.88	1.52	3.42	5.70
D. P. D. T. fused	1.67	2.58	5.62	9.88
T. P. S. T. fuseless	.78	1.40	2.86	5.14
T. P. S. T. fused	1.22	2.05	4.18	7.70
T. P. D. T. fuseless	1.37	2.35	5.24	8.82
T. P. D. T. fused	2.68	4.13	8.99	15.80

Lots $25 and more, list.

FUSES—Following are net prices of 250-volt inclosed fuses each, in standard packages, in cities named:

0-30 amperes	$0.11¼ each	110-200 amperes	$0.90 each
31-60 amperes	.15¾ each	225-400 amperes	1.62 each
61-100 amperes	.40 each		

FUSE PLUGS (MICA CAP) PER 100

0-30 amperes.. 4c. each in standard package quantities (500)
0.30 amperes.. 5c. each for less than standard package quantities (500)

SOCKETS, B. B. FINISH—Following are net prices in cents each in standard packages:

⅛-IN. OR PENDANT CAP			¾-IN. CAP		
Key	Keyless	Pull	Key	Keyless	Pull
22.10c.	21.00c.	42.00c.	27.30c.	26.20c.	46.20c.

Note—Less than standard package quantities, 15% off list.

CUT-OUTS—Following are net prices each in standard-package quantities:

CUT-OUTS, PLUG

S. P. M. L.	$0.11	T. P. to D. P. S. B.	$0.24
D. P. M. L.	.18	T. P. to D. P. T. B.	.38
T. P. M. L.	.26	T. P. S. B.	.33
D. P. S. B.	.19	T. P. D. B.	.54
D. P. D. B.	.37		

CUT-OUTS, N. E. C. FUSE

	0-30 Amp.	31-60 Amp.	60-100 Amp.
D. P. M. L.	$0.33	$0.84	$1.68
T. P. M. L.	.48	1.20	2.40
D. P. S. B.	.42	1.05	....
T. P. S. B.	.81	1.80	....
D. P. D. B.	.78	2.10	....
T. P. D. B.	1.35	3.60	....
T. P. to D. P. D. B.	.90	2.52	....

ATTACHMENT PLUGS—Price each, in standard packages:

		Standard Package
Hubbell porcelain	$0.21	250
Hubbell composition	.12	50
Benjamin swivel	.12	100
Current taps	.35	50

FLEXIBLE CORD—Price per 1000 ft. in coils of 250 ft.:

No. 18 cotton twisted	$21.50
No. 16 cotton twisted	29.00
No. 18 cotton parallel	24.00
No. 16 cotton parallel	36.00
No. 18 cotton reinforced heavy	28.50
No. 16 cotton reinforced heavy	39.40
No. 18 cotton reinforced light	24.00
No. 16 cotton reinforced light	32.00
No 18 cotton Canvasite cord	21.75
No. 16 cotton Canvasite cord	32.00

RUBBER-COVERED COPPER WIRE—Per 1000 ft. in New York:

No.	Solid, Single Braid	Solid, Double Braid	Stranded, Double Braid	Duplex
14	$10.50	$12.50	$15.00	$23.50
12	14.23	16.92	19.48	32.25
10	16.92	22.83	25.81	45.00
8	27.65	31.40	35.50	61.00
6	....	....	56.00	....
4	....	....	76.40	....
2	....	....	112.45	....
1	....	....	152.26	....
0	....	....	182.90	....
00	....	....	223.60	....
000	....	....	271.24	....
0000	....	....	332.40	....

COPPER WIRE—Prices per 1000 ft. for rubber-covered wire in following cities:

	Denver			St. Louis			Birmingham		
No.	Single Braid	Double Braid	Duplex	Single Braid	Double Braid	Duplex	Single Braid	Double Braid	Duplex
14	$13.00	$15.00	$26.00	$13.50	$16.25	$31.25	$13.50	$16.25	$31.25
10	23.30	26.50	52.55	25.00	28.50	56.40	25.00	28.50	56.40
8	33.10	36.70	73.20	34.85	38.85	74.70	34.85	38.85	74.70
6	.....	56.20	.....	59.75	64.25	....	59.75	64.25	....
4	.....	80.55	.....	84.40	84.90	....	84.40	84.90	....
2	.....	120.30	.....	125.50	132.00	....	125.50	132.00	....
1	.....	156.25	.....	163.00	171.15	....	163.00	171.15	....
0	.....	187.05	.....	216.00	225.00	....	216.00	225.00	....
00	.....	252.65	.....	263.00	273.50	....	263.00	273.50	....
000	.....	309.35	.....	320.00	331.50	....	320.00	331.50	....
0000	.....	376.75	.....	388.50	400.50	....	388.50	400.50	....

LOOM—Price per 100 ft., in coils:

Ft. in Coil			Ft. in Coil	
¼	250	$2.25	¾	150	$7.00
⅜	250	3.50	1	100	10.00
½	200	4.50	1¼	100	12.00
⅝	200	5.75	1½	100	15.00

CONDUITS, ELBOWS AND COUPLINGS—Following are warehouse net prices per 1000 ft. for conduit and per unit for elbows and couplings:

	Conduit		Elbows		Couplings	
In.	Enameled	Galvanized	Enameled	Galvanized	Enameled	Galvanized
½	$66.56	$71.66	$0.1602	$0.1716	$0.059	$0.0632
¾	87.75	94.65	.2108	.2258	.0843	.0903
1	129.71	139.91	.3119	.3341	.1096	.1174
1¼	175.49	189.29	.4019	.4289	.1518	.162
1½	209.83	226.33	.5358	.5718	.1875	.2001
2	282.31	304.51	.9823	1.05	.25	.266
2½	446.36	481.46	1.61	1.71	.3572	.381
3	583.70	629.60	4.28	4.57	.5358	.5718
3½	729.56	784.76	9.47	10.10	.7144	.7624
4	886.17	951.57	10.93	11.67	.893	.953

From New York Warehouse—Less 5% cash.

Standard lengths rigid, 10 ft. Standard lengths flexible, ½ in., 100 ft. Standard lengths flexible, ¾ to 2 in., 50 ft.

LOCKNUTS AND BUSHINGS—Following are net prices in standard packages, which are: ½-in., 1000; ¾- to 1¼-in., 100; 1½- to 2-in., 50:

	Locknuts Per 100	Bushings Per 100	Flexible Conduit Box Connections Per 100
½	$1.02	$1.68	$5.62
¾	1.75	4.00	7.12
1	3.00	6.15	10.50
1¼	5.00	8.20	15.00
1½	7.50	10.25	22.50
2	10.00	16.40	30.00
2½	12.30	24.60	67.50

ARMORED CABLES AND BOX CONNECTORS—Following are net prices per 1000 ft. cable and standard package of 100 box connectors in single and double strip:

Wire Gage	Twin Conductor Cable	Twin Conductor Connectors	Three Conductor Cable	Three Conductor Connectors
14	$65.00	$4.50	$103.50	$4.50
12	101.25	4.50	127.50	4.50
10	138.75	4.75	176.25	4.75
8	176.20	5.75	247.50	6.00
6	277.50	6.25	362.40	7.50
4	431.25	7.50	....	....

LAMPS—Below are present quotations in less than standard package quantities:

Straight-Side Bulbs				Pear-Shape Bulbs			
Mazda B— Watts	Plain	Frosted	No. in Package	Mazda C— Watts	Clear	Frosted	No. in Package
10	$0.30	$0.33	100	75	$0.70	$0.75	50
15	.30	.33	100	100	1.10	1.15	24
25	.30	.33	100	150	1.65	1.70	24
40	.30	.33	100	200	2.20	2.27	24
50	.30	.33	100	300	3.25	3.35	24
60	.35	.39	100	400	4.30	4.45	12
100	.70	.77	24	500	4.70	4.85	12
				750	6.50	6.75	8
				1000	7.50	7.75	8

Standard quantities are subject to discount of 10% from list. Annual contracts ranging from $150 to $300,000 net allow a discount of 17 to 40% from list.

WIRING SUPPLIES—New York prices for tape and solder are as follows:

Friction tape, ½-lb. rolls	35c. per lb.
Rubber tape, ½-lb. rolls	45c. per lb.
Wire solder, 50-lb. pools	45c. per lb.
Soldering paste, 1-lb. cans	50c. per lb.

FANS—It is prophesied that there will be a scarcity of electric fans this summer.

MISCELLANEOUS

HOSE—

	Fire 50-Ft. Lengths
Underwriters' 2½-in.	75c. per ft.
Common, 2½-in.	40%

	Air		
	First Grade	Second Grade	Third Grade
¾-in. per ft.	$0.55	$0.30	$0.25

Steam—Discounts from list

First grade... 30% Second grade... 30-5% Third grade... 40-10%

RUBBER BELTING—The following discounts from list apply to transmission rubber and duck belting:

Competition ..... 50% Best grade 20%
Standard 35%

LEATHER BELTING—Present discounts from list in the following cities are as follows:

	Medium Grade	Heavy Grade
New York	40%	35%
St. Louis	45%	40%
Chicago	30+10%	40+5%
Birmingham	35%	35%
Denver	35%	30%

RAWHIDE LACING—40%.

PACKING—Prices per pound:

Rubber and duck for low-pressure steam	$0.90
Asbestos for high-pressure steam	1.60
Duck and rubber for piston packing	1.00
Flax, regular	.90
Flax, waterproofed	1.10
Compressed abestos sheet	1.00
Wire insertion asbestos sheet	1.20
Rubber sheet	.60
Rubber sheet, wire insertion	.90
Rubber sheet, duck insertion	.50
Rubber sheet, cloth insertion	.25
Asbestos packing, twisted or braided and graphited, for valve stems and stuffing boxes	1.10
Asbestos wick, ½- and 1-lb. balls	.70

PIPE AND BOILER COVERING—Below are discounts and part of standard lists:

PIPE COVERING		BLOCKS AND SHEETS	
Pipe Size	Standard List Per Lin.Ft.	Thickness	Price per Sq.Ft.
1-in.	$0.27	½-in.	$0.27
2-in.	.36	1 -in.	.30
6-in.	.80	1½-in.	.45
4-in.	.60	2 -in.	.60
3-in.	.45	2½-in.	.75
8-in.	1.10	3 -in.	.90
10-in.	1.30	3½-in.	1.05

85% magnesia high pressure ..... 5% off

For low-pressure heating and return lines { 4-ply ..... 58% off; 3-ply ..... 60% off; 2-ply ..... 62% off

GREASES—Prices are as follows in the following cities in cents per pound for barrel lots:

	Cincinnati	Chicago	St. Louis	Birmingham	Denver
Cup	7	5¼	6.1	7½	10
Fiber or sponge	8	6	6.4	15	15
Transmission	7	6	6.4	10	15
Axle	4½	4	3.2	....	5
Gear	4½	4½	6.5	7½	6
Car journal	22 (gal.)	3½	4.6	5	6

COTTON WASTE—The following prices are in cents per pound:

	New York			
	Mar. 28, 1918	One Year Ago	Cleveland	Chicago
Colored mixed	8.50 to 12.00	10.00 to 12.00	12.50	12.00 to 12.50
White	11.00 to 13.00	13.00 to 15.00	16.00	10.00 to 11.00

WIPING CLOTHS—In Cleveland the jobbers' price per 1000 is as follows:

13¼ x 13½ ..... $45.00 13¼ x 20½ $52.00

In Chicago they sell at $30@33 per 1000.

LINSEED OIL—These prices are per gallon:

	New York		Cleveland		Chicago	
	Mar. 28, 1918	One Year Ago	Mar. 28, 1918	One Year Ago	Mar. 28, 1918	One Year Ago
Raw per barrel	$1.56*	$0.99	$1.60	$1.05	$1.65	$0.98
5-gal. cans	1.66*	1.09	1.75	1.15	1.75	1.08

* Nominal.

WHITE AND RED LEAD in 500-lb. lots sell as follows in cents per pound:

	Red				White			
	Mar. 28, 1918		1 Year Ago		Mar. 28, 1918		1 Yr. Ago	
	Dry	In Oil	Dry	In Oil	Dry and In Oil		Dry and In Oil	
25- and 50-lb. kegs	11.50	11.00	10.50	11.00	10.50		10.50	
12½-lb. keg	11.75	11.25	10.75	11.25	10.75		10.75	
100-lb. keg	11.25	11.50	11.00	11.50	11.00		11.00	
1- to 5-lb. cans	13.25	13.00	12.50	12.50	13.00		12.50	

RIVETS—The following quotations are allowed for fair-sized orders from warehouse:

	New York	Cleveland	Chicago
Steel ⅛ and smaller	30½	35%	40%*
Tinned	30%	35%	40%*

*For less than keg lots the discount is 35%.

Button heads, ¾, ⅞, 1 in. diameter by 2 in. to 5 in. sell as follows per 100 lb.:

New York ..... $6.09½ Cleveland ..... $5.85 Chicago $5.50

Cone heads, same sizes:

New York ..... $6.19½ Cleveland ..... $5.95 Chicago $5.60

FIRE BRICK—Quotations on the different kinds in the cities named are as follows, f.o.b. works:

	New York	Chicago
Silica brick, per 1000	$50.00 to 55.00	$50.00
Fire clay brick, per 1000, No. 1	45.00 to 55.00	.....
Magnesite brick, per net ton	135.00 to 145.00	.....
Chrome brick, per net ton	135.00	.....
Deadburned magnesite brick, per net ton	85.00 to 90.00	.....
Special furnace chrome brick, per net ton	60.00 to 70.00	60.00 to 80.00

Standard size fire brick, 9 x 4½ x 2½ in. The second quality is $4 to $5 cheaper per 1000.

St. Louis—High grade, $55 to $65; St. Louis grade, $40 to $50.
Birmingham—Fire clay, $25 to $30.
Chicago—Second quality, $25 per ton.
Denver—Silica, $35 per 1000.

FUEL OIL—Price variable, depending upon stock. New York quotations not available owing to this fact. In Chicago and St. Louis the following prices are quoted:

	Chicago	St. Louis
Domestic light, 22-26 Baumé	5c.	None
Mexican heavy, 12-14 Baumé	7c.	7 1/10c.

Note—There is practically no fuel oil in Chicago at present time.

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots, is:

	Mar. 28, 1918	One Year Ago
New York	$15.00	$8.00
Cleveland	15.30	7.50
Chicago	15.00	6.00

In coils an advance of 50c. usually is charged.
Note—Stock very scarce generally.

POLES—Prices on Western red cedar poles:

	New York	Chicago	St. Louis	Denver
6 in. by 30 ft.	$5.59	$4.94	$4.94	$4.32
7 in. by 30 ft.	7.40	6.60	6.60	5.80
7 in. by 35 ft.	10.70	9.60	9.60	8.55
8 in. by 35 ft.	12.20	10.90	10.90	9.65
7 in. by 40 ft.	12.35	11.00	11.00	9.75
8 in. by 40 ft.	13.75	12.15	12.15	10.65
8 in. by 45 ft.	18.20	16.20	16.20	14.30
8 in. by 50 ft.	21.85	19.45	19.45	17.15

10c. higher freight rates on account of double loads.

For plain pine poles, delivered New York, the price is as follows:

10-in. butts, 5-in. tops, length 20-30 ft.	$6.00
12-in. butts, 6-in. tops, length 30-40 ft.	8.50
12-in. butts, 6-in. tops, length 41-50 ft.	9.50
14-in. butts, 6-in. tops, length 51-60 ft.	17.00
14-in. butts, 6-in. tops, length 61-71 ft.	18.50

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh, basing card in effect July 2, 1917, for iron, and May 1 for steel:

BUTT WELD

Steel			Iron		
Inches	Black	Galvanized	Inches	Black	Galvanized
¼ to 3	49%	35½%	¼ to 1½	33%	17%

LAP WELD

2	42%	30½%	2	26%	12%
2½ to 6	45%	32½%	2½ to 4	28%	15%
7 to 12	42%	28½%	4½ to 6	28%	15%
13 and 14	32½%	....	7 to 8	20%	8%
15	30%	....			

BUTT WELD, EXTRA STRONG PLAIN ENDS

¼ to 1½	47%	34½%	¼ to 1½	33%	18%
2 to 3	48%	35½%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	40%	28½%	2	27%	14%
2¼ to 4	43%	31½%	9 to 12	15%	3%
4½ to 6	42%	30½%	7 to 12	25%	12%
7 to 8	38%	24½%	2½ to 4	29%	17%
9 to 12	33%	19½%	4½ to 6	28%	16%

From warehouses at the places named the following discounts hold for steel pipe:

	Black		
	New York	Chicago	St. Louis
¼ to 3 in. butt welded	38%	42%	34.27%
3½ to 6 in. lap welded	18%	38%	21.27%
7 to 12 in. lap welded	10%	35%	21.27%

	Galvanized		
	New York	Chicago	St. Louis
¼ to 3 in. butt welded	22%	22%	19.27%
3½ to 6 in. lap welded	List	18%	13.27%
7 to 12 in. lap welded	List+20%	20%	6.27%

Malleable fittings, Class B and C, from New York stock sell at 5 and 5% from list prices. Cast iron, standard sizes, 34 and 5%.

BOILER TUBES—The following are the prices for carload lots f.o.b. Pittsburgh, announced Nov. 13, as agreed upon by manufacturers and the Government:

Lap Welded Steel		Charcoal Iron	
3½ to 4½ in.	34	3½ to 4½ in.	12½
2½ to 3¼ in.	24	3 to 3¼ in.	+ 5
2¼ in.	17½	2½ to 2¾ in.	+ 7½
1¾ to 2 in.	13	2 to 2¼ in.	+22½
		1¾ to 1⅞ in.	+35

Standard Commercial Seamless—Cold drawn or hot rolled:

	Per Net Ton		Per Net Ton
1 in.	$340	1¾ in.	$220
1¼ in.	280	2 to 2½ in.	190
1⅜ in.	270	2¾ to 3¾ in.	180
1½ in.	220	4 in.	200
		4½ to 5 in.	220

These prices do not apply to special specifications for locomotive tubes nor to special specifications for tubes for the Navy Department, which will be subject to special negotiation.